

## CLAIMS

1. A method for rendering a surface of a substrate hydrophilic, comprising the steps of:
- 5 preparing a substrate coated with a photocatalytic layer comprised of a photocatalyst; and,
- subjecting said photocatalyst to photoexcitation to thereby cause molecules of water to be physically adsorbed onto the surface of said photocatalytic layer under the
- 10 photocatalytic action of the photocatalyst whereby the surface of the substrate is rendered hydrophilic.
2. A composite with a hydrophilic surface, comprising:
- 15 a substrate having a surface;
- a photocatalytic layer comprised of a photocatalyst, said layer being bonded to the surface of said substrate; and,
- molecules of water physically adsorbed onto the surface of said photocatalytic layer upon photoexcitation of the photocatalyst.
- 20 3. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising a photocatalyst operable upon photoexcitation thereof to cause molecules of water to be
- 25 physically adsorbed onto the surface of said coating under the photocatalytic action of the photocatalyst to thereby render the surface hydrophilic.
4. A composite with a hydrophilic surface, comprising:
- 30 a substrate having a surface; and,
- a photocatalytic layer comprised of a photocatalyst, said layer being bonded to the surface of said substrate;
- said photocatalyst operating upon photoexcitation thereof to render the surface of said composite hydrophilic such that the surface of said composite presents a water

wettability of less than about 5° in terms of the contact angle with water.

5. An antifogging transparent sheet member comprising:  
a transparent substrate having a surface; and,  
5 a substantially transparent photocatalytic layer  
comprised of a photocatalyst, said photocatalytic layer being  
bonded to the surface of said substrate;  
said photocatalyst operating upon photoexcitation  
thereof to render the surface of said layer hydrophilic on the  
10 order of less than about 5° in terms of the contact angle with  
water whereby adherent moisture condensate and/or water  
droplets are caused to spread over the surface of said layer to  
thereby prevent the substrate from being fogged or blurred with  
adherent moisture condensate and/or water droplets.
- 15 6. An antifogging mirror comprising:  
a substrate having a surface and a reflective  
coating; and,  
a substantially transparent photocatalytic layer  
20 comprised of a photocatalyst, said photocatalytic layer being  
bonded to the surface of said substrate;  
said photocatalyst operating upon photoexcitation  
thereof to render the surface of said layer hydrophilic on the  
order of less than about 5° in terms of the contact angle with  
25 water whereby adherent moisture condensate and/or water  
droplets are caused to spread over the surface of said layer to  
thereby prevent the substrate from being fogged or blurred with  
adherent moisture condensate and/or water droplets.
- 30 7. An antifogging lens comprising:  
a transparent lens-forming body having a surface;  
and,  
a substantially transparent photocatalytic layer  
comprised of a photocatalyst, said photocatalytic layer being

bonded to the surface of said lens-forming body;

5        said photocatalyst operating upon photoexcitation thereof to render the surface of said layer hydrophilic on the order of less than about 5° in terms of the contact angle with water whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer to thereby prevent the lens-forming body from being fogged or blurred with adherent moisture condensate and/or water droplets.

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8. A composite according to claim 4, wherein said photocatalytic layer is resistant to adhesion by deposits and contaminants when contacted with an aqueous substance.

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9. A composite according to claim 8, wherein, for self-cleaning of the composite, said photocatalytic layer operates to permit adherent deposits and/or contaminants to be washed away by rainwater as said composite is subjected to rainfall.

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10. A composite according to claim 8, wherein said photocatalytic layer operates to prevent contaminants from adhering to the surface thereof as contaminant-laden rainwater flows therealong.

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11. A composite according to claim 8, wherein, to facilitate cleansing of the composite with water, said photocatalytic layer operates to release adherent deposits and/or contaminants when soaked in or wetted with water.

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12. A composite according to claim 4, wherein said photocatalytic layer is resistant to the formation of water droplets on the surface of said layer.

13. A composite according to claim 12, wherein, for prevention of growth of water droplets, said photocatalytic

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layer operates to cause adherent moisture condensate and/or water droplets to spread over the surface of said layer.

14. A composite according to claim 12, wherein, to  
5 promote drying of the substrate after wetted with water, said photocatalytic layer operates to cause adherent water droplets to spread over the surface of said layer.

15. A composite according to claim 4, wherein the surface  
10 of said layer is further coated with a hydrophilic protective layer.

16. A composite according to claim 4, wherein the surface  
of said layer is further coated with a photocatalytic  
15 protective layer which is adapted to be rendered hydrophilic upon photoexcitation.

17. A composite according to claim 4, wherein said  
photocatalyst comprises an oxide selected from the group  
20 consisting of  $\text{TiO}_2$ ,  $\text{ZnO}$ ,  $\text{SnO}_2$ ,  $\text{SrTiO}_3$ ,  $\text{WO}_3$ ,  $\text{Bi}_2\text{O}_3$  and  $\text{Fe}_2\text{O}_3$ .

18. A composite according to claim 4, wherein said  
photocatalyst comprises the anatase form of titania.

19. A composite according to claim 4, wherein said  
25 photocatalyst comprises the rutile form of titania.

20. A composite according to claim 4, wherein said  
photocatalytic layer further comprises  $\text{SiO}_2$  or  $\text{SnO}_2$ .

21. A composite according to claim 4, wherein said  
30 photocatalytic layer comprises a coating in which particles of said photocatalyst are uniformly dispersed.

22. A composite according to claim 4, wherein said

photocatalytic layer is comprised of silicone having organic groups bonded to silicon atoms of silicone molecules, and wherein the surface of said photocatalytic layer is formed of a derivative of silicone in which the organic groups bonded to the silicon atoms of the silicone molecules have been substituted upon photoexcitation at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst.

23. A composite according to claim 4, further comprising an intermediate layer of a non-decomposable material interleaved between said substrate and said photocatalytic layer.

24. A composite according to claim 4, wherein said substrate contains alkaline metal ions or alkaline-earth metal ions and wherein a thin film for preventing said ions from diffusing from said substrate into said photocatalytic layer is interleaved between said substrate and said photocatalytic layer.

25. A composite according to claim 24, wherein said thin film comprises silica.

26. A composite according to claim 4, wherein the thickness of said photocatalytic layer is less than about 0.2 micrometers.

27. A composite according to claim 4, wherein said photocatalytic layer further comprises a metal selected from the group consisting of Ag, Cu and Zn.

28. A composite according to claim 4, wherein said photocatalytic layer further comprises a metal selected from the group consisting of Pt, Pd, Rh, Ru, Os and Ir.

29. A method for rendering a surface of a substrate hydrophilic, comprising the steps of:

preparing a substrate coated with a layer comprised of a photocatalyst; and,

5       subjecting said photocatalyst to photoexcitation until the surface of said layer presents a water-wettability of less than about 5° in terms of the contact angle with water.

30. An antifogging method for preventing a transparent sheet member from being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

10       preparing a transparent sheet member coated with a substantially transparent layer comprised of a photocatalyst; and,

15       subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than about 5° in terms of the contact angle with water whereby  
20       adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer.

31. An antifogging method for preventing a mirror from being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

25       preparing a mirror coated with a substantially transparent layer comprised of a photocatalyst; and,

30       subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than about 5° in terms of the contact angle with water whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer.

35       32. An antifogging method for preventing a lens from being

fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

preparing a lens coated with a substantially transparent layer comprised of a photocatalyst; and,

5        subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than about 5° in terms of the contact angle with water whereby adherent moisture condensate and/or water droplets are caused  
10      to spread over the surface of said layer.

33. A method for cleaning a substrate, comprising the steps of:

preparing a substrate coated with a layer comprised  
15      of a photocatalyst;

disposing said substrate outdoors;

subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than  
20      about 5° in terms of the contact angle with water; and,

subjecting said substrate to rainfall whereby deposits and/or contaminants adhering on the surface of said layer are washed away by rainwater.

25        34. A method for cleaning a substrate, comprising the steps of:

preparing a substrate coated with a layer comprised of a photocatalyst;

subjecting said photocatalyst to photoexcitation to  
30      thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than about 5° in terms of the contact angle with water; and,

rinsing said substrate with water whereby organic deposits and/or contaminants adhering on the surface of said  
35      layer are released therefrom and washed away by water.

35. A method for cleaning a substrate, comprising the steps of:

5 preparing a substrate coated with a layer comprised of a photocatalyst;

subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than about 5° in terms of the contact angle with water; and,

10 causing said substrate soaked in or wetted with water whereby organic deposits and/or contaminants adhering on the surface of said layer are released therefrom.

36. A method for maintaining a surface of a substrate disposed outdoors clean, comprising the steps of:

15 preparing a substrate coated with a layer comprised of a photocatalyst;

disposing said substrate outdoors; and,

20 subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than about 5° in terms of the contact angle with water whereby contaminants are prevented from adhering to the surface of said substrate as contaminant-laden rainwater flows therealong.

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37. A method for preventing growth of water droplets adhering on a substrate, comprising the steps of:

preparing a substrate coated with a layer comprised of a photocatalyst;

30 subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than about 5° in terms of the contact angle with water; and,

35 causing adherent moisture condensate and/or water droplets to spread over the surface of said layer.



38. A method according to one of claims 29-37, wherein the step of subjecting said photocatalyst to photoexcitation is carried out with the sunlight.

39. A method according to one of claims 29-37, wherein the step of subjecting said photocatalyst to photoexcitation is carried out with an electric lamp selected from the group  
5 consisting of fluorescent lamp, incandescent lamp, metal halide lamp, and mercury lamp.

40. A method for rendering a surface of a substrate hydrophilic, comprising the steps of:  
10 coating the surface of the substrate with a layer comprised of a photocatalyst; and,  
subjecting said photocatalyst to photoexcitation until the surface of said layer presents a water-wettability of less than about 5° in terms of the contact angle with water.  
15

41. An antifogging method for preventing a transparent sheet member from being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:  
20 preparing a transparent sheet member;  
coating the surface of said transparent sheet member with a substantially transparent layer comprised of a photocatalyst; and,  
subjecting said photocatalyst to photoexcitation to  
25 thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than about 5° in terms of the contact angle with water whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer.  
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42. An antifogging method for preventing a mirror from

being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

- preparing a mirror;
- coating the surface of said mirror with a
- 5 substantially transparent layer comprised of a photocatalyst;
- and,

subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than  
10 about 5° in terms of the contact angle with water whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer.

43. An antifogging method for preventing a lens from  
15 being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

- preparing a lens;
- coating the surface of said lens with a substantially transparent layer comprised of a photocatalyst; and,
- 20 subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than about 5° in terms of the contact angle with water whereby adherent moisture condensate and/or water droplets are caused  
25 to spread over the surface of said layer.

44. A method for cleaning a substrate, comprising the steps of:

- preparing a substrate;
- 30 coating the surface of said substrate with a layer comprised of a photocatalyst;
- disposing said substrate outdoors;
- subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the  
35 surface of said layer presents a water-wettability of less than

about 5° in terms of the contact angle with water; and,  
subjecting said substrate to rainfall whereby  
deposits and/or contaminants adhering on the surface of said  
layer are washed away by rainwater.

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45. A method for cleaning a substrate, comprising the  
steps of:

preparing a substrate;  
coating the surface of said substrate with a layer  
10 comprised of a photocatalyst;  
subjecting said photocatalyst to photoexcitation to  
thereby render the surface of said layer hydrophilic until the  
surface of said layer presents a water-wettability of less than  
about 5° in terms of the contact angle with water; and,  
15 rinsing said substrate with water whereby organic  
deposits and/or contaminants adhering on the surface of said  
layer are released therefrom and washed away by water.

46. A method for cleaning a substrate, comprising the  
20 steps of:

preparing a substrate;  
coating the surface of said substrate with a layer  
comprised of a photocatalyst;  
subjecting said photocatalyst to photoexcitation to  
25 thereby render the surface of said layer hydrophilic until the  
surface of said layer presents a water-wettability of less than  
about 5° in terms of the contact angle with water; and,  
causing said substrate soaked in or wetted with water  
whereby organic deposits and/or contaminants adhering on the  
30 surface of said layer are released therefrom.

47. A method for maintaining a surface of a substrate  
disposed outdoors clean, comprising the steps of:

preparing a substrate;  
35 coating the surface of said substrate with a layer

comprised of a photocatalyst;

disposing said substrate outdoors; and,

subjecting said photocatalyst to photoexcitation to  
thereby render the surface of said layer hydrophilic until the  
5 surface of said layer presents a water-wettability of less than  
about 5° in terms of the contact angle with water whereby  
contaminants are prevented from adhering to the surface of said  
substrate as contaminant-laden rainwater flows therealong.

10 48. A method for preventing growth of water droplets  
adhering on a substrate, comprising the steps of:

preparing a substrate having a surface;

coating the surface of said substrate with a layer  
comprised of a photocatalyst;

15 subjecting said photocatalyst to photoexcitation to  
thereby render the surface of said layer hydrophilic until the  
surface of said layer presents a water-wettability of less than  
about 5° in terms of the contact angle with water; and,

causing adherent moisture condensate and/or water  
20 droplets to spread over the surface of said layer.

49. A method according to one of claims 40-48, wherein  
the step of subjecting said photocatalyst to photoexcitation is  
carried out with the sunlight.

50. A method according to one of claims 40-48, wherein  
the step of subjecting said photocatalyst to photoexcitation is  
carried out with an electric lamp selected from the group  
25 consisting of fluorescent lamp, incandescent lamp, metal halide  
lamp, and mercury lamp.

51. A method of manufacturing a composite with a  
hydrophilic surface, comprising the steps of:  
30 preparing a substrate having a surface; and,  
coating the surface of said substrate with a photo-

reactive layer comprised of a photocatalyst and operable to present upon photoexcitation a water wettability of less than about 5° in terms of the contact angle with water.

- 5           52. A method of manufacturing an antifogging transparent sheet member, comprising the steps of:

                  preparing a transparent substrate having a surface;  
and,

                  coating the surface of said substrate with a  
10 substantially transparent photo-reactive layer comprised of a photocatalyst and operable to present upon photoexcitation a water wettability of less than about 5° in terms of the contact angle with water.

- 15           53. A method of manufacturing a self-cleaning composite, comprising the steps of:

                  preparing a substrate having a surface; and,  
                  coating the surface of said substrate with a photo-reactive layer comprised of a photocatalyst and operable to  
20 present upon photoexcitation a water wettability of less than about 5° in terms of the contact angle with water.

54. A method of manufacturing an antifogging mirror, comprising the steps of:

25                   preparing a substrate with or without a reflective coating, said substrate having a surface;

                  coating the surface of said substrate with a substantially transparent photo-reactive layer comprised of a photocatalyst and operable to present upon photoexcitation a  
30 water wettability of less than about 5° in terms of the contact angle with water; and,

                  forming where necessary a reflective coating on the opposite surface of said substrate prior to or subsequent to or during the course of said step of coating.

55. A method of manufacturing an antifogging lens, comprising the steps of:

preparing a lens-forming body having a surface; and,  
coating the surface of said body with a substantially  
5 transparent photo-reactive layer comprised of a photocatalyst  
and operable to present upon photoexcitation a water  
wettability of less than about 5° in terms of the contact angle  
with water.

10 56. A method according to one of claims 51-55, wherein  
said step of coating comprises the substeps of:

(a) coating the surface with a thin film of amorphous  
titania; and,

(b) heating said thin film at a temperature less than  
15 the softening point of the substrate to transform amorphous  
titania into crystalline titania.

57. A method according to claim 56, wherein prior to said  
substep (a) the substrate is coated with a thin film of silica  
20 to prevent alkaline network-modifier ions from diffusing from  
the substrate into said photocatalytic layer.

58. A method according to claim 56, wherein said substep  
(a) is carried out by applying onto the surface a solution of  
25 an organic compound of titanium, followed by subjecting said  
compound to hydrolysis and dehydration polymerization to form  
said thin film of amorphous titania over the surface.

59. A method according to claim 58, wherein said organic  
30 compound of titanium is selected from the group consisting of  
an alkoxide of titanium, a chelate of titanium and an acetate  
of titanium.

60. A method according to claim 56, wherein said step (a)  
35 is carried out by applying onto the surface a solution of an

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inorganic compound of titanium, followed by subjecting said compound to hydrolysis and dehydration polymerization to form said thin film of amorphous titania over the surface.

5        61. A method according to claim 60, wherein said inorganic compound of titanium is  $\text{TiCl}_4$  or  $\text{Ti}(\text{SO}_4)_2$ .

62. A method according to claim 56, wherein said step (a) is carried out by sputtering.

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63. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising a photocatalyst operable upon photoexcitation thereof to render the surface of said  
15 coating hydrophilic on the order of less than about  $5^\circ$  in terms of the contact angle with water.

64. A coating composition according to claim 63, wherein the surface of said coating thus rendered hydrophilic upon  
20 photoexcitation is operable to permit adherent moisture condensate and/or water droplets to spread thereover to thereby prevent the substrate from being fogged or blurred with adherent moisture condensate and/or water droplets.

25        65. A coating composition according to claim 63, wherein the surface of said coating thus rendered hydrophilic upon photoexcitation is operable to permit adherent deposits and/or contaminants to be washed away by rainwater as the substrate is subjected to rainfall whereby the surface is self-cleaned.

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66. A coating composition according to claim 63, wherein the surface of said coating thus rendered hydrophilic upon photoexcitation is operable to prevent contaminants from  
35 therealong.

67. A coating composition according to claim 63, wherein the surface of said coating thus rendered hydrophilic upon photoexcitation is operable to release adherent deposits and/or contaminants when soaked in or wetted with water to thereby  
5 facilitate cleansing of the substrate with water.

68. A coating composition according to claim 63, wherein the surface of said coating thus rendered hydrophilic upon photoexcitation is operable to permit adherent moisture  
10 condensate and/or water droplets to spread thereover to thereby prevent growth of water droplets.

69. A coating composition according to claim 63, wherein the surface of said coating thus rendered hydrophilic upon  
15 photoexcitation is operable to permit adherent moisture condensate and/or water droplets to spread thereover to thereby promote drying of the substrate after wetted with water.

70. A composite with a hydrophilic surface, comprising:  
20 a substrate; and,  
a photocatalytic layer bonded to the surface of said substrate and comprised of a coating wherein particles of a photocatalyst are uniformly dispersed;  
said photocatalyst operating upon photoexcitation  
25 thereof to render the surface of said composite hydrophilic such that the surface of said composite presents a water wettability of less than about 5° in terms of the contact angle with water.

71. An antifogging transparent sheet member comprising:  
30 a transparent substrate; and,  
a substantially transparent photocatalytic layer bonded to the surface of said substrate and comprised of a coating wherein particles of a photocatalyst are uniformly



dispersed;

said photocatalyst operating upon photoexcitation thereof to render the surface of said layer hydrophilic such that the surface of said layer presents a water wettability of less than about 5° in terms of the contact angle with water whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer to thereby prevent the substrate from being fogged or blurred with adherent moisture condensate and/or water droplets.

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72. An antifogging mirror comprising:

a substrate with a reflective coating; and,

a substantially transparent photocatalytic layer

bonded to the front surface of said substrate and comprised of a coating wherein particles of a photocatalyst are uniformly dispersed;

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said photocatalyst operating upon photoexcitation thereof to render the surface of said layer hydrophilic such that the surface of said layer presents a water wettability of less than about 5° in terms of the contact angle with water whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer to thereby prevent the substrate from being fogged or blurred with adherent moisture condensate and/or water droplets.

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73. An antifogging lens comprising:

a transparent lens-forming body; and,

a substantially transparent photocatalytic layer

bonded to the surface of said lens-forming body and comprised

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of a coating wherein particles of a photocatalyst are uniformly dispersed;

said photocatalyst operating upon photoexcitation thereof to render the surface of said layer hydrophilic such that the surface of said layer presents a water wettability of less than about 5° in terms of the contact angle with water

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whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer to thereby prevent the lens-forming body from being fogged or blurred with adherent moisture condensate and/or water droplets.

5

74. A composite with a hydrophilic surface, comprising:  
a substrate having a surface; and,  
a photocatalytic layer bonded to the surface of said  
substrate and comprised of a coating in which particles of a  
10 photocatalyst are uniformly dispersed;

said photocatalyst operating upon photoexcitation  
thereof to render the surface of the composite hydrophilic  
whereby adherent deposits and/or contaminants are washed away  
by rainwater to self-clean the composite as it is subjected to  
15 rainfall.

75. A composite with a hydrophilic surface, comprising:  
a substrate; and,  
a photocatalytic layer bonded to the surface of said  
20 substrate and comprised of a coating wherein particles of a  
photocatalyst are uniformly dispersed;  
said photocatalyst operating upon photoexcitation  
thereof to render the surface of the composite hydrophilic  
whereby contaminants are prevented from adhering to the surface  
25 of the composite as contaminant-laden rainwater flows  
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76. A composite with a hydrophilic surface, comprising:  
a substrate; and,  
a photocatalytic layer bonded to the surface of said  
30 substrate and comprised of a coating wherein particles of a  
photocatalyst are uniformly dispersed;

said photocatalyst operating upon photoexcitation  
thereof to render the surface of the composite hydrophilic  
whereby deposits and/or contaminants adhering to the surface

are released therefrom when soaked in or wetted with water to thereby facilitate cleansing of the composite with water.

- 5           77. A composite with a hydrophilic surface, comprising:  
          a substrate; and,  
          a photocatalytic layer bonded to the surface of said  
substrate and comprised of a coating wherein particles of a  
photocatalyst are uniformly dispersed;  
          said photocatalyst operating upon photoexcitation  
10 thereof to render the surface of the composite hydrophilic  
whereby adherent moisture condensate and/or water droplets are  
caused to spread over the surface of said layer to thereby  
prevent growth of water droplets.
- 15           78. A composite with a hydrophilic surface, comprising:  
          a substrate; and,  
          a photocatalytic layer bonded to the surface of said  
substrate and comprised of a coating wherein particles of a  
photocatalyst are uniformly dispersed;  
20           said photocatalyst operating upon photoexcitation  
thereof to render the surface of the composite hydrophilic  
whereby adherent water droplets are caused to spread over the  
surface of said layer to thereby promote drying of the  
composite after wetted with water.
- 25           79. A composite with a hydrophilic surface, comprising:  
          a substrate;  
          a photocatalytic layer bonded to the surface of said  
substrate and comprised of a coating wherein particles of a  
30 photocatalyst are uniformly dispersed; and,  
          a hydrophilic protective layer covering said  
photocatalytic layer;  
          said photocatalyst operating upon photoexcitation  
thereof to render the surface of the composite hydrophilic.

80. A composite with a hydrophilic surface, comprising:  
a substrate;  
a photocatalytic layer bonded to the surface of said  
substrate and comprised of a coating wherein particles of a  
5 photocatalyst are uniformly dispersed; and,  
a protective layer covering said photocatalytic  
layer, said protective layer being adapted to be rendered  
hydrophilic upon photoexcitation;  
said photocatalyst operating upon photoexcitation  
10 thereof to render the surface of the composite hydrophilic.

81. A composite with a hydrophilic surface, comprising:  
a substrate; and,  
a photocatalytic layer bonded to the surface of said  
15 substrate and comprised of a coating wherein particles of a  
photocatalyst are uniformly dispersed, said photocatalyst  
comprising an oxide selected from the group consisting of  $\text{TiO}_2$ ,  
 $\text{ZnO}$ ,  $\text{SnO}_2$ ,  $\text{SrTiO}_3$ ,  $\text{WO}_3$ ,  $\text{Bi}_2\text{O}_3$  and  $\text{Fe}_2\text{O}_3$ ;  
said photocatalyst operating upon photoexcitation  
20 thereof to render the surface of the composite hydrophilic.

82. A composite with a hydrophilic surface, comprising:  
a substrate; and,  
a photocatalytic layer bonded to the surface of said  
25 substrate and comprised of a coating wherein particles of a  
photocatalyst comprising the anatase form of titania are  
uniformly dispersed;  
said photocatalyst operating upon photoexcitation  
thereof to render the surface of the composite hydrophilic.

30  
83. A composite with a hydrophilic surface, comprising:  
a substrate; and,  
a photocatalytic layer bonded to the surface of said  
substrate and comprised of a coating wherein particles of a  
35 photocatalyst comprising the rutile form of titania are

uniformly dispersed;

said photocatalyst operating upon photoexcitation thereof to render the surface of the composite hydrophilic.

5        84. A composite with a hydrophilic surface, comprising:  
a substrate;

a photocatalytic layer bonded to the surface of said substrate and comprised of a coating wherein particles of a photocatalyst comprising the rutile form of titania are  
10 uniformly dispersed, said photocatalyst operating upon photoexcitation thereof to render the surface of the composite hydrophilic; and,

an intermediate layer of a non-decomposable material interleaved between said substrate and said photocatalytic layer.  
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85. A composite with a hydrophilic surface, comprising:  
a substrate, said substrate containing alkaline metal ions and/or alkaline-earth metal ions;

20 a photocatalytic layer bonded to the surface of said substrate and comprised of a coating wherein particles of a photocatalyst comprising the rutile form of titania are uniformly dispersed, said photocatalyst operating upon photoexcitation thereof to render the surface of the composite hydrophilic; and,  
25

a diffusion prevention thin film interleaved between said substrate and said photocatalytic layer to prevent said ions from diffusing from said substrate into said photocatalytic layer.  
30

86. A composite according to claim 85, wherein said thin film is comprised of silica.

87. A composite with a hydrophilic surface, comprising:  
35 a substrate; and,

a photocatalytic layer bonded to the surface of said substrate and comprised of a coating wherein particles of a photocatalyst are uniformly dispersed;

said photocatalytic layer having a thickness of less than about 0.2 micrometers;

said photocatalyst operating upon photoexcitation thereof to render the surface of the composite hydrophilic.

88. A composite with a hydrophilic surface, comprising:  
a substrate; and,

a photocatalytic layer bonded to the surface of said substrate and comprised of a coating wherein particles of a photocatalyst are uniformly dispersed;

said photocatalytic layer further comprising a metal selected from the group consisting of Ag, Cu and Zn;

said photocatalyst operating upon photoexcitation thereof to render the surface of the composite hydrophilic.

89. A composite with a hydrophilic surface, comprising:  
a substrate; and,

a photocatalytic layer bonded to the surface of said substrate and comprised of a coating wherein particles of a photocatalyst are uniformly dispersed;

said photocatalytic layer further comprising a metal selected from the group consisting of Pt, Pd, Rh, Ru, Os and Ir;

said photocatalyst operating upon photoexcitation thereof to render the surface of the composite hydrophilic.

90. A composite with a hydrophilic surface, comprising:  
a substrate; and,

a photocatalytic layer bonded to the surface of said substrate and comprised of a coating wherein particles of a photocatalyst are uniformly dispersed;

said photocatalyst operating upon photoexcitation

thereof to render the surface of said composite hydrophilic such that the surface of said composite presents a water wettability of less than about 10° in terms of the contact angle with water.

5           91. A composite according to claim 90, wherein upon photoexcitation the surface of said composite presents a water wettability of less than about 5° in terms of the contact angle with water.

10           92. A composite with a hydrophilic surface, comprising:  
a substrate having a surface; and,  
a photocatalytic layer bonded to the surface of said substrate, said photocatalytic layer comprising a photocatalyst and SiO<sub>2</sub> or SnO<sub>2</sub>;  
said photocatalyst operating upon photoexcitation  
15 thereof to render the surface of the composite hydrophilic.

20           93. An antifogging transparent sheet member comprising:  
a transparent substrate; and,  
a substantially transparent photocatalytic layer  
bonded to the surface of said substrate and comprised of a photocatalyst and SiO<sub>2</sub> or SnO<sub>2</sub>;  
said photocatalyst operating upon photoexcitation  
thereof to render the surface of said layer hydrophilic whereby  
adherent moisture condensate and/or water droplets are caused  
25 to spread over the surface of said layer to thereby prevent the substrate from being fogged or blurred with adherent moisture condensate and/or water droplets.

30           94. An antifogging mirror comprising:  
a substrate with a reflective coating; and,  
a substantially transparent photocatalytic layer  
bonded to the front surface of said substrate and comprised of a photocatalyst and SiO<sub>2</sub> or SnO<sub>2</sub>;

said photocatalyst operating upon photoexcitation thereof to render the surface of said layer hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer to thereby prevent the substrate from being fogged or blurred with adherent moisture condensate and/or water droplets.

95. An antifogging lens comprising:  
a transparent lens-forming body; and,  
a substantially transparent photocatalytic layer  
bonded to the surface of said lens-forming body and comprised of a photocatalyst and SiO<sub>2</sub> or SnO<sub>2</sub>;

said photocatalyst operating upon photoexcitation thereof to render the surface of said layer hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer to thereby prevent the lens-forming body from being fogged or blurred with adherent moisture condensate and/or water droplets.

96. A composite with a hydrophilic surface, comprising:  
a substrate; and,  
a photocatalytic layer bonded to the surface of said substrate and comprised of a photocatalyst and SiO<sub>2</sub> or SnO<sub>2</sub>;  
said photocatalyst operating upon photoexcitation thereof to render the surface of the composite hydrophilic whereby adherent deposits and/or contaminants are washed away by rainwater to self-clean the composite as it is subjected to rainfall.

97. A composite with a hydrophilic surface, comprising:  
a substrate; and,  
a photocatalytic layer bonded to the surface of said substrate and comprised of a photocatalyst and SiO<sub>2</sub> or SnO<sub>2</sub>;  
said photocatalyst operating upon photoexcitation thereof to render the surface of the composite hydrophilic



whereby contaminants are prevented from adhering to the surface of the composite as contaminant-laden rainwater flows therealong.

- 5            98. A composite with a hydrophilic surface, comprising:  
             a substrate; and,  
             a photocatalytic layer bonded to the surface of said  
             substrate and comprised of a photocatalyst and  $\text{SiO}_2$  or  $\text{SnO}_2$ ;  
             said photocatalyst operating upon photoexcitation  
10 thereof to render the surface of the composite hydrophilic  
             whereby deposits and/or contaminants adhering to the surface  
             are released therefrom when soaked in or wetted with water to  
             thereby facilitate cleansing of the composite with water.
- 15            99. A composite with a hydrophilic surface, comprising:  
             a substrate; and,  
             a photocatalytic layer bonded to the surface of said  
             substrate and comprised of a photocatalyst and  $\text{SiO}_2$  or  $\text{SnO}_2$ ;  
             said photocatalyst operating upon photoexcitation  
20 thereof to render the surface of the composite hydrophilic  
             whereby adherent moisture condensate and/or water droplets are  
             caused to spread over the surface of said layer to thereby  
             prevent growth of water droplets.
- 25            100. A composite with a hydrophilic surface, comprising:  
             a substrate; and,  
             a photocatalytic layer bonded to the surface of said  
             substrate and comprised of a photocatalyst and  $\text{SiO}_2$  or  $\text{SnO}_2$ ;  
             said photocatalyst operating upon photoexcitation  
30 thereof to render the surface of the composite hydrophilic  
             whereby adherent water droplets are caused to spread over the  
             surface of said layer to thereby promote drying of the  
             composite after wetted with water.
- 35            101. A composite according to one of claims 92-100,

wherein upon photoexcitation the surface of said composite presents a water wettability of less than about 10° in terms of the contact angle with water.

102. A composite according to claim 101, wherein upon  
5 photoexcitation the surface of said composite presents a water wettability of less than about 5° in terms of the contact angle with water.

103. A composite with a hydrophilic surface, comprising:  
10 a substrate having a surface; and,  
a photocatalytic coating bonded to the surface of said substrate and comprised of a photocatalyst and silicone having organic groups bonded to silicon atoms of silicone molecules;

15 wherein due to photoexcitation of said photocatalyst said organic group at the surface of said photocatalytic coating are substituted at least in part with hydroxyl groups under the photocatalytic action of the photocatalyst thereby rendering the surface of the composite hydrophilic.

20 104. An antifogging transparent sheet member comprising:  
a transparent substrate having a surface; and,  
a substantially transparent photocatalytic coating bonded to the surface of said substrate and comprised of a  
25 photocatalyst and silicone having organic groups bonded to silicon atoms of silicone molecules;

wherein due to photoexcitation of said photocatalyst said organic group at the surface of said photocatalytic coating are substituted at least in part with hydroxyl groups  
30 under the photocatalytic action of the photocatalyst thereby rendering the surface of the sheet member hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said coating to thereby prevent the substrate from being fogged or blurred with adherent

moisture condensate and/or water droplets.

105. An antifogging mirror comprising:

5 a substrate having a surface and a reflective coating; and,

a substantially transparent photocatalytic coating bonded to the surface of said substrate and comprised of a photocatalyst and silicone having organic groups bonded to silicon atoms of silicone molecules;

10 wherein due to photoexcitation of said photocatalyst said organic group at the surface of said photocatalytic coating are substituted at least in part with hydroxyl groups under the photocatalytic action of the photocatalyst thereby rendering the surface of the mirror hydrophilic whereby  
15 adherent moisture condensate and/or water droplets are caused to spread over the surface of said coating to thereby prevent the substrate from being fogged or blurred with adherent moisture condensate and/or water droplets.

20 106. An antifogging lens comprising:

a transparent lens-forming body having a surface; and,

25 a substantially transparent photocatalytic coating bonded to the surface of said lens-forming body and comprised of a photocatalyst and silicone having organic groups bonded to silicon atoms of silicone molecules;

30 wherein due to photoexcitation of said photocatalyst said organic group at the surface of said photocatalytic coating are substituted at least in part with hydroxyl groups under the photocatalytic action of the photocatalyst thereby rendering the surface of the lens hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said coating to thereby prevent the body from being fogged or blurred with adherent moisture condensate  
35 and/or water droplets.

107. A composite with a hydrophilic surface, comprising:  
a substrate having a surface; and,  
a photocatalytic coating bonded to the surface of  
5 said substrate and comprised of a photocatalyst and silicone  
having organic groups bonded to silicon atoms of silicone  
molecules;

wherein due to photoexcitation of said photocatalyst  
said organic group at the surface of said photocatalytic  
10 coating are substituted at least in part with hydroxyl groups  
under the photocatalytic action of the photocatalyst thereby  
rendering the surface of the composite hydrophilic whereby  
adherent deposits and/or contaminants are washed away by  
rainwater to self-clean the composite as it is subjected to  
15 rainfall.

108. A composite with a hydrophilic surface, comprising:  
a substrate having a surface; and,  
a photocatalytic coating bonded to the surface of  
20 said substrate and comprised of a photocatalyst and silicone  
having organic groups bonded to silicon atoms of silicone  
molecules;

wherein due to photoexcitation of said photocatalyst  
said organic group at the surface of said photocatalytic  
25 coating are substituted at least in part with hydroxyl groups  
under the photocatalytic action of the photocatalyst thereby  
rendering the surface of the composite hydrophilic whereby  
contaminants are prevented from adhering to the surface of the  
composite as contaminant-laden rainwater flows therealong.

30

109. A composite with a hydrophilic surface, comprising:  
a substrate having a surface; and,  
a photocatalytic coating bonded to the surface of  
said substrate and comprised of a photocatalyst and silicone  
35 having organic groups bonded to silicon atoms of silicone

molecules;

wherein due to photoexcitation of said photocatalyst said organic group at the surface of said photocatalytic coating are substituted at least in part with hydroxyl groups under the photocatalytic action of the photocatalyst thereby rendering the surface of the composite hydrophilic whereby deposits and/or contaminants adhering to the surface are released therefrom when soaked in or wetted with water to thereby facilitate cleansing of the composite with water.

10

110. A composite with a hydrophilic surface, comprising:  
a substrate having a surface; and,  
a photocatalytic coating bonded to the surface of said substrate and comprised of a photocatalyst and silicone having organic groups bonded to silicon atoms of silicone molecules;

wherein due to photoexcitation of said photocatalyst said organic group at the surface of said photocatalytic coating are substituted at least in part with hydroxyl groups under the photocatalytic action of the photocatalyst thereby rendering the surface of the composite hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of the coating to thereby prevent growth of water droplets.

25

111. A composite with a hydrophilic surface, comprising:  
a substrate having a surface; and,  
a photocatalytic coating bonded to the surface of said substrate and comprised of a photocatalyst and silicone having organic groups bonded to silicon atoms of silicone molecules;

wherein due to photoexcitation of said photocatalyst said organic group at the surface of said photocatalytic coating are substituted at least in part with hydroxyl groups under the photocatalytic action of the photocatalyst thereby

35

rendering the surface of the composite hydrophilic whereby adherent water droplets are caused to spread over the surface of the coating to thereby promote drying of the composite after wetted with water.

5

112. A composite according to one of claims 103-111, wherein upon photoexcitation the surface of said composite presents a water wettability of less than about  $10^\circ$  in terms of the contact angle with water.

10

113. A composite according to claim 112, wherein upon photoexcitation the surface of said composite presents a water wettability of less than about  $5^\circ$  in terms of the contact angle with water.

15

114. An antifogging sheet glass adapted to prevent moisture condensate and/or water droplets adhering on the surface thereof from fogging or blurring the sheet glass, said sheet glass comprising:

20

a transparent substrate having a surface; and,  
a substantially transparent coating of silicone which is bonded to the surface of said substrate and in which particles of a photocatalyst are uniformly dispersed, said silicone having organic groups bonded to silicon atoms of silicone molecules;

wherein said organic groups at the surface of said coating are capable of being substituted, upon photoexcitation of said photocatalyst, at least in part with hydroxyl groups whereby the surface of said substrate is rendered highly hydrophilic.

25

115. An antifogging mirror adapted to prevent moisture condensate and/or water droplets adhering on the surface thereof from fogging or blurring the mirror, said mirror comprising:

a substrate having a surface and a reflective coating; and,

a substantially transparent coating of silicone which is bonded to the surface of said substrate and in which  
5 particles of a photocatalyst are uniformly dispersed, said silicone having organic groups bonded to silicon atoms of silicone molecules;

wherein said organic groups at the surface of said coating are capable of being substituted, upon photoexcitation of said photocatalyst, at least in part with hydroxyl groups whereby the surface of said substrate is rendered highly hydrophilic.

116. An antifogging lens adapted to prevent moisture  
10 condensate and/or water droplets adhering on the surface thereof from fogging or blurring the lens, said lens comprising:

a transparent lens-forming body having a surface;

and,

15 a substantially transparent coating of silicone which is bonded to the surface of said body and in which particles of a photocatalyst are uniformly dispersed, said silicone having organic groups bonded to silicon atoms of silicone molecules;  
wherein said organic groups at the surface of said coating are capable of being substituted, upon photoexcitation of said photocatalyst, at least in part with hydroxyl groups whereby the surface of said substrate is rendered highly hydrophilic.

20 117. A composite with a hydrophilifiable surface, comprising:

a substrate having a surface; and,

a photocatalytic coating bonded to the surface of said substrate and comprised of a photocatalyst and silicone  
25 having organic groups bonded to silicon atoms of silicone

molecules;

wherein said organic groups at the surface of said coating are capable of being substituted, upon photoexcitation of said photocatalyst, at least in part with hydroxyl groups to render the surface of said composite hydrophilic such that the surface of said composite presents a water wettability of less than about 10° in terms of the contact angle with water.

118. A composite with a hydrophilifiable surface, comprising:

a substrate having a surface; and,  
a photocatalytic coating bonded to the surface of said substrate and comprised of a photocatalyst and silicone having organic groups bonded to silicon atoms of silicone molecules;

wherein said organic groups at the surface of said coating are capable of being substituted, upon photoexcitation of said photocatalyst, at least in part with hydroxyl groups to render the surface of said composite hydrophilic such that the surface of said composite presents a water wettability of less than about 10° in terms of the contact angle with water whereby adherent deposits and/or contaminants are washed away by rainwater to self-clean the composite as it is subjected to rainfall.

119. A composite with a hydrophilifiable surface, comprising:

a substrate having a surface; and,  
a photocatalytic coating bonded to the surface of said substrate and comprised of a photocatalyst and silicone having organic groups bonded to silicon atoms of silicone molecules;

wherein said organic groups at the surface of said coating are capable of being substituted, upon photoexcitation of said photocatalyst, at least in part with hydroxyl groups to



render the surface of said composite hydrophilic such that the surface of said composite presents a water wettability of less than about  $10^\circ$  in terms of the contact angle with water whereby contaminants are prevented from adhering to the surface of the composite as contaminant-laden rainwater flows therealong.

120. A composite with a hydrophilifiable surface, comprising:

a substrate having a surface; and,  
a photocatalytic coating bonded to the surface of said substrate and comprised of a photocatalyst and silicone having organic groups bonded to silicon atoms of silicone molecules;

wherein said organic groups at the surface of said coating are capable of being substituted, upon photoexcitation of said photocatalyst, at least in part with hydroxyl groups to render the surface of said composite hydrophilic such that the surface of said composite presents a water wettability of less than about  $10^\circ$  in terms of the contact angle with water whereby deposits and/or contaminants adhering to the surface are released therefrom when soaked in or wetted with water to thereby facilitate cleansing of the composite with water.

121. A composite with a hydrophilifiable surface, comprising:

a substrate having a surface; and,  
a photocatalytic coating bonded to the surface of said substrate and comprised of a photocatalyst and silicone having organic groups bonded to silicon atoms of silicone molecules;

wherein said organic groups at the surface of said coating are capable of being substituted, upon photoexcitation of said photocatalyst, at least in part with hydroxyl groups to render the surface of said composite hydrophilic such that the surface of said composite presents a water wettability of less

than about 10° in terms of the contact angle with water whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of the coating to thereby prevent growth of water droplets.

5

122. A composite with a hydrophilifiable surface, comprising:

a substrate having a surface; and,

10 a photocatalytic coating bonded to the surface of said substrate and comprised of a photocatalyst and silicone having organic groups bonded to silicon atoms of silicone molecules;

15 wherein said organic groups at the surface of said coating are capable of being substituted, upon photoexcitation of said photocatalyst, at least in part with hydroxyl groups to render the surface of said composite hydrophilic such that the surface of said composite presents a water wettability of less than about 10° in terms of the contact angle with water whereby adherent water droplets are caused to spread over the surface  
20 of the coating to thereby promote drying of the composite after wetted with water.

123. A method of manufacturing a composite with a hydrophilifiable surface, comprising the steps of:  
25 preparing a substrate having a surface;  
applying onto the surface of the substrate a suspension comprising crystalline titania particles dispersed in a precursor of amorphous silica; and,

30 subjecting said precursor to hydrolysis where necessary and to dehydration polymerization to thereby form on said surface a photo-reactive layer of titania particles bound by amorphous silica.

124. A method of manufacturing an antifogging transparent  
35 sheet member, comprising the steps of:

preparing a transparent substrate having a surface;  
applying onto the surface of the substrate a  
suspension comprising crystalline titania particles dispersed  
in a precursor of amorphous silica; and,

5       subjecting said precursor to hydrolysis where  
necessary and to dehydration polymerization to thereby form on  
said surface a substantially transparent photo-reactive layer  
of titania particles bound by amorphous silica.

10       125. A method of manufacturing a self-cleaning composite,  
comprising the steps of:

preparing a substrate having a surface;  
applying onto the surface of the substrate a  
suspension comprising crystalline titania particles dispersed  
15    in a precursor of amorphous silica; and,

subjecting said precursor to hydrolysis where  
necessary and to dehydration polymerization to thereby form on  
said surface a photo-reactive layer of titania particles bound  
by amorphous silica.

20       126. A method of manufacturing an antifogging mirror,  
comprising the steps of:

preparing a substrate with or without a reflective  
coating, said substrate having a surface;

25       applying onto the surface of the substrate a  
suspension comprising crystalline titania particles dispersed  
in a precursor of amorphous silica;

subjecting said precursor to hydrolysis where  
necessary and to dehydration polymerization to thereby form on  
30    said surface a substantially transparent photo-reactive layer  
of titania particles bound by amorphous silica; and,

forming where necessary a reflective coating on the  
opposite surface of said substrate prior to or subsequent to or  
during the course of said step of applying a suspension.

35

127. A method of manufacturing an antifogging lens, comprising the steps of:

- 5 preparing a lens-forming body having a surface;  
applying onto the surface of the substrate a  
suspension comprising crystalline titania particles dispersed  
in a precursor of amorphous silica; and,  
10 subjecting said precursor to hydrolysis where  
necessary and to dehydration polymerization to thereby form on  
said surface a substantially transparent photo-reactive layer  
of titania particles bound by amorphous silica.

128. A method according to one of claims 123-127, wherein said precursor is tetraalkoxysilane, silanol, polysiloxane having an average molecular weight of less than 3000, or a mixture thereof.

129. A method of manufacturing a composite with a hydrophilifiable surface, comprising the steps of:  
15 preparing a substrate having a surface;  
applying onto the surface of the substrate a  
suspension comprising particles of silica dispersed in a  
solution of an organic compound of titanium;  
subjecting said compound to hydrolysis and  
20 dehydration polymerization to form a thin film of amorphous  
titania in which particles of silica are dispersed; and,  
heating said film at a temperature less than the  
softening point of the substrate to transform amorphous titania  
into crystalline titania to thereby form a photo-reactive  
25 coating of photocatalytic titania in which particles of silica  
are dispersed.

130. A method of manufacturing an antifogging transparent sheet member, comprising the steps of:

- 30 preparing a transparent substrate having a surface;  
applying onto the surface of the substrate a

suspension comprising particles of silica dispersed in a solution of an organic compound of titanium;

subjecting said compound to hydrolysis and dehydration polymerization to form a thin film of amorphous titania in which particles of silica are dispersed; and,  
5 heating said film at a temperature less than the softening point of the substrate to transform amorphous titania into crystalline titania to thereby form a substantially transparent photo-reactive coating of photocatalytic titania in  
10 which particles of silica are dispersed.

131. A method of manufacturing a self-cleaning composite, comprising the steps of:

preparing a substrate having a surface;  
15 applying onto the surface of the substrate a suspension comprising particles of silica dispersed in a solution of an organic compound of titanium;  
subjecting said compound to hydrolysis and dehydration polymerization to form a thin film of amorphous  
20 titania in which particles of silica are dispersed; and,  
heating said film at a temperature less than the softening point of the substrate to transform amorphous titania into crystalline titania to thereby form a photo-reactive coating of photocatalytic titania in which particles of silica  
25 are dispersed.

132. A method of manufacturing an antifogging mirror, comprising the steps of:

preparing a substrate with or without a reflective  
30 coating, said substrate having a surface;  
applying onto the surface of the substrate a suspension comprising particles of silica dispersed in a solution of an organic compound of titanium;  
subjecting said compound to hydrolysis and  
35 dehydration polymerization to form a thin film of amorphous

titania in which particles of silica are dispersed;

heating said film at a temperature less than the softening point of the substrate to transform amorphous titania into crystalline titania to thereby form a substantially transparent photo-reactive coating of photocatalytic titania in which particles of silica are dispersed; and,

forming where necessary a reflective coating on the opposite surface of said substrate prior to or subsequent to or during the course of said step of applying a suspension.

133. A method of manufacturing an antifogging lens, comprising the steps of:

preparing a lens-forming body having a surface;

applying onto the surface of the body a suspension comprising particles of silica dispersed in a solution of an organic compound of titanium;

subjecting said compound to hydrolysis and dehydration polymerization to form a thin film of amorphous titania in which particles of silica are dispersed; and,

heating said film at a temperature less than the softening point of the body to transform amorphous titania into crystalline titania to thereby form a substantially transparent photo-reactive coating of photocatalytic titania in which particles of silica are dispersed.

134. A method according to one of claims 129-133, wherein said organic compound of titanium is selected from the group consisting of an alkoxide of titanium, a chelate of titanium and an acetate of titanium.

135. A method of manufacturing a composite with a hydrophilifiable surface, comprising the steps of:

preparing a substrate having a surface;

applying onto the surface of the substrate a suspension comprising particles of crystalline titania and

particles of silica; and,

heating said substrate at a temperature less than the softening point thereof to bond particles to said substrate and to sinter particles with each other to thereby form a photo-reactive coating comprised of sintered particles of titania and silica.

136. A method of manufacturing an antifogging transparent sheet member, comprising the steps of:

10 preparing a transparent substrate having a surface;  
applying onto the surface of the substrate a suspension comprising particles of crystalline titania and particles of silica; and,

15 heating said substrate at a temperature less than the softening point thereof to bond particles to said substrate and to sinter particles with each other to thereby form a substantially transparent photo-reactive coating comprised of sintered particles of titania and silica.

20 137. A method of manufacturing a self-cleaning composite, comprising the steps of:

preparing a substrate having a surface;  
applying onto the surface of the substrate a suspension comprising particles of crystalline titania and particles of silica; and,

25 heating said substrate at a temperature less than the softening point thereof to bond particles to said substrate and to sinter particles with each other to thereby form a photo-reactive coating comprised of sintered particles of titania and silica.

138. A method of manufacturing an antifogging mirror, comprising the steps of:

35 preparing a substrate with or without a reflective coating, said substrate having a surface;

applying onto the surface of the substrate a suspension comprising particles of crystalline titania and particles of silica;

5 heating said substrate at a temperature less than the softening point thereof to bond particles to said substrate and to sinter particles with each other to thereby form a substantially transparent photo-reactive coating comprised of sintered particles of titania and silica; and,

10 forming where necessary a reflective coating on the opposite surface of said substrate prior to or subsequent to or during the course of said step of applying a suspension.

139. A method of manufacturing an antifogging lens, comprising the steps of:

15 preparing a lens-forming body having a surface; applying onto the surface of the body a suspension comprising particles of crystalline titania and particles of silica; and,

20 heating said body at a temperature less than the softening point thereof to bond particles to said substrate and to sinter particles with each other to thereby form a substantially transparent photo-reactive coating comprised of sintered particles of titania and silica.

25 140. A method of manufacturing a composite with a hydrophilifiable surface, comprising the steps of:

30 preparing a substrate having a surface; applying onto the surface of the substrate a suspension comprising particles of the anatase form of titania and particles of tin oxide; and,

35 heating said substrate at a temperature of less than 900°C to bond particles to said substrate and to sinter particles with each other to thereby form a photo-reactive coating comprised of sintered particles of titania and tin oxide.



141. A method of manufacturing an antifogging transparent sheet member, comprising the steps of:

5 preparing a transparent substrate having a surface;  
applying onto the surface of the substrate a suspension comprising particles of the anatase form of titania and particles of tin oxide; and,

10 heating said substrate at a temperature of less than 900°C to bond particles to said substrate and to sinter particles with each other to thereby form a substantially transparent photo-reactive coating comprised of sintered particles of titania and tin oxide.

142. A method of manufacturing a self-cleaning composite,  
15 comprising the steps of:

preparing a substrate having a surface;  
applying onto the surface of the substrate a suspension comprising particles of the anatase form of titania and particles of tin oxide; and,

20 heating said substrate at a temperature of less than 900°C to bond particles to said substrate and to sinter particles with each other to thereby form a photo-reactive coating comprised of sintered particles of titania and tin oxide.

25 143. A method of manufacturing an antifogging mirror, comprising the steps of:

preparing a substrate with or without a reflective coating, said substrate having a surface;  
30 applying onto the surface of the substrate a suspension comprising particles of the anatase form of titania and particles of tin oxide;

heating said substrate at a temperature of less than 900°C to bond particles to said substrate and to sinter  
35 particles with each other to thereby form a substantially

transparent photo-reactive coating comprised of sintered particles of titania and tin oxide; and,

forming where necessary a reflective coating on the opposite surface of said substrate prior to or subsequent to or during the course of said step of applying a suspension.

144. A method of manufacturing an antifogging lens, comprising the steps of:

preparing a lens-forming body having a surface;  
applying onto the surface of the substrate a suspension comprising particles of the anatase form of titania and particles of tin oxide;  
heating said body at a temperature of less than 900°C to bond particles to said substrate and to sinter particles with each other to thereby form a substantially transparent photo-reactive coating comprised of sintered particles of titania and tin oxide.

145. A method of manufacturing a composite with a hydrophilifiable surface, comprising the steps of:

preparing a substrate having a surface;  
applying onto the surface of the substrate a suspension comprising particles of tin oxide dispersed in a solution of an organic compound of titanium;  
subjecting said compound to hydrolysis and dehydration polymerization to thereby form a thin film of amorphous titania in which particles of tin oxide are dispersed; and,

heating said thin film at a temperature of less than 900°C to transform amorphous titania into crystalline titania to thereby form a photo-reactive coating of photocatalytic titania in which particles of tin oxide are dispersed.

146. A method of manufacturing an antifogging transparent sheet member, comprising the steps of:

preparing a transparent substrate having a surface;  
applying onto the surface of the substrate a  
suspension comprising particles of tin oxide dispersed in a  
solution of an organic compound of titanium;

5       subjecting said compound to hydrolysis and  
dehydration polymerization to thereby form a thin film of  
amorphous titania in which particles of tin oxide are  
dispersed; and,

10       heating said thin film at a temperature of less than  
900°C to transform amorphous titania into crystalline titania  
to thereby form a substantially transparent photo-reactive  
coating of photocatalytic titania in which particles of tin  
oxide are dispersed.

15       147. A method of manufacturing a self-cleaning composite,  
comprising the steps of:

20       preparing a substrate having a surface;  
applying onto the surface of the substrate a  
suspension comprising particles of tin oxide dispersed in a  
solution of an organic compound of titanium;

25       subjecting said compound to hydrolysis and  
dehydration polymerization to thereby form a thin film of  
amorphous titania in which particles of tin oxide are  
dispersed; and,

heating said thin film at a temperature of less than  
900°C to transform amorphous titania into crystalline titania  
to thereby form a photo-reactive coating of photocatalytic  
titania in which particles of tin oxide are dispersed.

30       148. A method of manufacturing an antifogging mirror,  
comprising the steps of:

preparing a substrate with or without a reflective  
coating, said substrate having a surface;

35       applying onto the surface of the substrate a  
suspension comprising particles of tin oxide dispersed in a

solution of an organic compound of titanium;

subjecting said compound to hydrolysis and  
dehydration polymerization to thereby form a thin film of  
amorphous titania in which particles of tin oxide are  
5 dispersed;

heating said thin film at a temperature of less than  
900°C to transform amorphous titania into crystalline titania  
to thereby form a substantially transparent photo-reactive  
coating of photocatalytic titania in which particles of tin  
10 oxide are dispersed; and,

forming where necessary a reflective coating on the  
opposite surface of said substrate prior to or subsequent to or  
during the course of said step of applying a suspension.

15 149. A method of manufacturing an antifogging lens,  
comprising the steps of:

preparing a lens-forming body having a surface;  
applying onto the surface of the body a suspension  
comprising particles of tin oxide dispersed in a solution of an  
20 organic compound of titanium;

subjecting said compound to hydrolysis and  
dehydration polymerization to thereby form a thin film of  
amorphous titania in which particles of tin oxide are  
dispersed; and,

25 heating said thin film at a temperature of less than  
900°C to transform amorphous titania into crystalline titania  
to thereby form a substantially transparent photo-reactive  
coating of photocatalytic titania in which particles of tin  
oxide are dispersed.

30 150. A method of manufacturing a composite with a  
hydrophilic surface, comprising the steps of:  
preparing a substrate having a surface;  
applying onto the surface of the substrate a coating  
35 composition comprising particles of a photocatalyst and a film-

forming element of uncured or partially cured silicone or a precursor thereof;

curing said film-forming element to form a silicone coating in which particles of the photocatalyst are uniformly dispersed, said silicone coating having organic groups bonded to silicon atoms of silicone molecules; and,

subjecting the photocatalyst to photoexcitation so that said organic groups at the surface of the coating are substituted at least in part with hydroxyl groups.

10

151. A method of manufacturing an antifogging transparent sheet member, comprising the steps of:

preparing a transparent substrate having a surface; applying onto the surface of the substrate a coating composition comprising particles of a photocatalyst and a film-forming element of uncured or partially cured silicone or a precursor thereof;

curing said film-forming element to form a substantially transparent silicone coating in which particles of the photocatalyst are uniformly dispersed, said silicone coating having organic groups bonded to silicon atoms of silicone molecules; and,

subjecting the photocatalyst to photoexcitation so that said organic groups at the surface of the coating are substituted at least in part with hydroxyl groups.

152. A method of manufacturing a self-cleaning composite, comprising the steps of:

preparing a substrate having a surface; applying onto the surface of the substrate a coating composition comprising particles of a photocatalyst and a film-forming element of uncured or partially cured silicone or a precursor thereof;

curing said film-forming element to form a silicone coating in which particles of the photocatalyst are uniformly

dispersed, said silicone coating having organic groups bonded to silicon atoms of silicone molecules; and,

subjecting the photocatalyst to photoexcitation so that said organic groups at the surface of the coating are substituted at least in part with hydroxyl groups.

153. A method of manufacturing an antifogging mirror, comprising the steps of:

preparing a substrate with or without a reflective coating, said substrate having a surface;

applying onto the surface of the substrate a coating composition comprising particles of a photocatalyst and a film-forming element of uncured or partially cured silicone or a precursor thereof;

curing said film-forming element to form a substantially transparent silicone coating in which particles of the photocatalyst are uniformly dispersed, said silicone coating having organic groups bonded to silicon atoms of silicone molecules;

subjecting the photocatalyst to photoexcitation so that said organic groups at the surface of the coating are substituted at least in part with hydroxyl groups; and,

forming where necessary a reflective coating on the opposite surface of said substrate prior to or subsequent to or during the course of said step of applying a coating composition.

154. A method of manufacturing an antifogging lens, comprising the steps of:

preparing a lens-forming body having a surface;

applying onto the surface of the body a coating composition comprising particles of a photocatalyst and a film-forming element of uncured or partially cured silicone or a precursor thereof;

curing said film-forming element to form a

substantially transparent silicone coating in which particles of the photocatalyst are uniformly dispersed, said silicone coating having organic groups bonded to silicon atoms of silicone molecules; and,

- 5       subjecting the photocatalyst to photoexcitation so that said organic groups at the surface of the coating are substituted at least in part with hydroxyl groups.

155. A method according to one of claims 150-154, wherein  
10       said step of subjecting the photocatalyst to photoexcitation is carried out until the water wettability of the surface of said coating becomes less than about 10° in terms of the contact angle with water.

156. A method according to claim 155, wherein said step of  
15       subjecting the photocatalyst to photoexcitation is carried out until the water wettability of the surface of said coating becomes less than about 5° in terms of the contact angle with water.

20       157. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

25       a film-forming element comprising a precursor of amorphous silica and capable of forming a coating of amorphous silica when cured; and,

30       particles of photocatalytic titania dispersed in said film-forming element for rendering upon photoexcitation the surface of said coating hydrophilic on the order of less than about 10° in terms of the contact angle with water.

158. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

35       a film-forming element comprising a precursor of

amorphous silica and capable of forming a coating of amorphous silica when cured; and,

particles of photocatalytic titania dispersed in said film-forming element for rendering upon photoexcitation the surface of said coating hydrophilic;

said coating having the surface thus rendered hydrophilic being operable to permit adherent moisture condensate and/or water droplets to spread thereover to thereby prevent the substrate from being fogged or blurred with adherent moisture condensate and/or water droplets.

159. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a film-forming element comprising a precursor of amorphous silica and capable of forming a coating of amorphous silica when cured; and,

particles of photocatalytic titania dispersed in said film-forming element for rendering upon photoexcitation the surface of said coating hydrophilic;

said coating having the surface thus rendered hydrophilic being operable to permit adherent deposits and/or contaminants to be washed away by rainwater as said substrate is subjected to rainfall to thereby permit self-cleaning of the substrate.

160. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a film-forming element comprising a precursor of amorphous silica and capable of forming a coating of amorphous silica when cured; and,

particles of photocatalytic titania dispersed in said film-forming element for rendering upon photoexcitation the surface of said coating hydrophilic;



said coating having the surface thus rendered hydrophilic being operable to prevent contaminants from adhering to the surface thereof as contaminant-laden rainwater flows therealong.

5

161. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a film-forming element comprising a precursor of amorphous silica and capable of forming a coating of amorphous silica when cured; and, particles of photocatalytic titania dispersed in said film-forming element for rendering upon photoexcitation the surface of said coating hydrophilic;

15 said coating having the surface thus rendered hydrophilic being operable to release adherent deposits and/or contaminants when soaked in or wetted with water to thereby facilitate cleansing of the substrate with water.

20 162. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a film-forming element comprising a precursor of amorphous silica and capable of forming a coating of amorphous silica when cured; and, particles of photocatalytic titania dispersed in said film-forming element for rendering upon photoexcitation the surface of said coating hydrophilic;

25 said coating having the surface thus rendered hydrophilic being operable to cause adherent moisture condensate and/or water droplets to spread over the surface of the coating to thereby prevent growth of water droplets.

30 163. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate,

35

said coating composition comprising:

a film-forming element comprising a precursor of amorphous silica and capable of forming a coating of amorphous silica when cured; and,

5 particles of photocatalytic titania dispersed in said film-forming element for rendering upon photoexcitation the surface of said coating hydrophilic;

said coating having the surface thus rendered hydrophilic being operable to cause adherent water droplets to  
10 spread over the surface of the coating to thereby promote drying of the substrate after wetted with water.

164. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate,  
15 said coating composition comprising:

a film-forming element comprising a precursor of amorphous silica and capable of forming a coating of amorphous silica when cured, said precursor being tetraalkoxysilane, silanol, polysiloxane having an average molecular weight of  
20 less than 3000, or a mixture thereof; and,

particles of photocatalytic titania dispersed in said film-forming element for rendering upon photoexcitation the surface of said coating hydrophilic.

25 165. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a film-forming element comprising a precursor of amorphous titania and capable of forming a coating of  
30 photocatalytic titania upon curing and calcination; and, particles of silica dispersed in said film-forming element;

said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic on the  
35 order of less than about  $10^\circ$  in terms of the contact angle with

water.

166. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a film-forming element comprising a precursor of amorphous titania and capable of forming a coating of photocatalytic titania upon curing and calcination; and, particles of silica dispersed in said film-forming element;

said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said coating to thereby prevent the substrate from being fogged or blurred with adherent moisture condensate and/or water droplets.

167. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a film-forming element comprising a precursor of amorphous titania and capable of forming a coating of photocatalytic titania upon curing and calcination; and, particles of silica dispersed in said film-forming element;

said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic whereby adherent deposits and/or contaminants are away by rainwater as said substrate is subjected to rainfall to thereby permit self-cleaning of the substrate.

168. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a film-forming element comprising a precursor of

amorphous titania and capable of forming a coating of photocatalytic titania upon curing and calcination; and, particles of silica dispersed in said film-forming element;

5           said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic whereby contaminants are prevented from adhering to the surface of the substrate as contaminant-laden rainwater flows therealong.

10           169. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

15                 a film-forming element comprising a precursor of amorphous titania and capable of forming a coating of photocatalytic titania upon curing and calcination; and, particles of silica dispersed in said film-forming element;

20                 said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic whereby deposits and/or contaminants adhering to the surface are released therefrom when soaked in or wetted with water to thereby facilitate cleansing of the substrate with water.

25           170. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

30                 a film-forming element comprising a precursor of amorphous titania and capable of forming a coating of photocatalytic titania upon curing and calcination; and, particles of silica dispersed in said film-forming element;

35                 said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of the coating to thereby prevent

growth of water droplets.

171. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a film-forming element comprising a precursor of amorphous titania and capable of forming a coating of photocatalytic titania upon curing and calcination; and, particles of silica dispersed in said film-forming element;

said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic whereby adherent water droplets are caused to spread over the surface of the coating to thereby promote drying of the substrate after wetted with water.

172. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a film-forming element comprising a precursor of amorphous titania and capable of forming a coating of photocatalytic titania upon curing and calcination, said precursor being selected from the group consisting of an alkoxide of titanium, a chelate of titanium and an acetate of titanium.; and,

particles of silica dispersed in said film-forming element;

said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic.

173. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a suspension comprising particles of photocatalytic titania and particles of silica;

said coating composition being capable of forming a photo-reactive coating comprised of sintered particles of photocatalytic titania and silica upon application on the substrate followed by sintering;

5        said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic on the order of less than about  $10^\circ$  in terms of the contact angle with water.

10        174. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a suspension comprising particles of photocatalytic titania and particles of silica;

15        said coating composition being capable of forming a photo-reactive coating comprised of sintered particles of photocatalytic titania and silica upon application on the substrate followed by sintering;

20        said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said coating to thereby prevent the substrate from being fogged or blurred with adherent moisture condensate and/or water droplets.

25        175. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

30        a suspension comprising particles of photocatalytic titania and particles of silica;

said coating composition being capable of forming a photo-reactive coating comprised of sintered particles of photocatalytic titania and silica upon application on the substrate followed by sintering;

35        said photocatalytic titania rendering upon

photoexcitation the surface of said coating hydrophilic whereby adherent deposits and/or contaminants are away by rainwater as said substrate is subjected to rainfall to thereby permit self-cleaning of the substrate.

5

176. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a suspension comprising particles of photocatalytic  
10 titania and particles of silica;

said coating composition being capable of forming a photo-reactive coating comprised of sintered particles of photocatalytic titania and silica upon application on the substrate followed by sintering;

15 said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic whereby contaminants are prevented from adhering to the surface of the substrate as contaminant-laden rainwater flows therealong.

20 177. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a suspension comprising particles of photocatalytic  
titania and particles of silica;

25 said coating composition being capable of forming a photo-reactive coating comprised of sintered particles of photocatalytic titania and silica upon application on the substrate followed by sintering;

30 said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic whereby deposits and/or contaminants adhering to the surface are released therefrom when soaked in or wetted with water to thereby facilitate cleansing of the substrate with water.

35 178. A coating composition for use in forming a

photocatalytically hydrophilifiable coating on a substrate,  
said coating composition comprising:

a suspension comprising particles of photocatalytic  
titania and particles of silica;

5        said coating composition being capable of forming a  
photo-reactive coating comprised of sintered particles of  
photocatalytic titania and silica upon application on the  
substrate followed by sintering;

10        said photocatalytic titania rendering upon  
photoexcitation the surface of said coating hydrophilic whereby  
adherent moisture condensate and/or water droplets are caused  
to spread over the surface of the coating to thereby prevent  
growth of water droplets.

15        179. A coating composition for use in forming a  
photocatalytically hydrophilifiable coating on a substrate,  
said coating composition comprising:

a suspension comprising particles of photocatalytic  
titania and particles of silica;

20        said coating composition being capable of forming a  
photo-reactive coating comprised of sintered particles of  
photocatalytic titania and silica upon application on the  
substrate followed by sintering;

25        said photocatalytic titania rendering upon  
photoexcitation the surface of said coating hydrophilic whereby  
adherent water droplets are caused to spread over the surface  
of the coating to thereby promote drying of the substrate after  
wetted with water.

30        180. A coating composition for use in forming a  
photocatalytically hydrophilifiable coating on a substrate,  
said coating composition comprising:

a suspension comprising particles of photocatalytic  
titania and particles of tin oxide;

35        said coating composition being capable of forming a



photo-reactive coating comprised of sintered particles of photocatalytic titania and tin oxide upon application on the substrate followed by sintering;

5       said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic on the order of less than about  $10^\circ$  in terms of the contact angle with water.

181. A coating composition for use in forming a  
10   photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

      a suspension comprising particles of photocatalytic titania and particles of tin oxide;

15       said coating composition being capable of forming a photo-reactive coating comprised of sintered particles of photocatalytic titania and tin oxide upon application on the substrate followed by sintering;

      said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic whereby  
20   adherent moisture condensate and/or water droplets are caused to spread over the surface of said coating to thereby prevent the substrate from being fogged or blurred with adherent moisture condensate and/or water droplets.

25       182. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

      a suspension comprising particles of photocatalytic titania and particles of tin oxide;

30       said coating composition being capable of forming a photo-reactive coating comprised of sintered particles of photocatalytic titania and tin oxide upon application on the substrate followed by sintering;

      said photocatalytic titania rendering upon  
35   photoexcitation the surface of said coating hydrophilic whereby

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adherent deposits and/or contaminants are away by rainwater as said substrate is subjected to rainfall to thereby permit self-cleaning of the substrate.

5        183. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

        a suspension comprising particles of photocatalytic titania and particles of tin oxide;

10        said coating composition being capable of forming a photo-reactive coating comprised of sintered particles of photocatalytic titania and tin oxide upon application on the substrate followed by sintering;

        said photocatalytic titania rendering upon  
15 photoexcitation the surface of said coating hydrophilic whereby contaminants are prevented from adhering to the surface of the substrate as contaminant-laden rainwater flows therealong.

        184. A coating composition for use in forming a  
20 photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

        a suspension comprising particles of photocatalytic titania and particles of tin oxide;

        said coating composition being capable of forming a  
25 photo-reactive coating comprised of sintered particles of photocatalytic titania and tin oxide upon application on the substrate followed by sintering;

        said photocatalytic titania rendering upon  
photoexcitation the surface of said coating hydrophilic whereby  
30 deposits and/or contaminants adhering to the surface are released therefrom when soaked in or wetted with water to thereby facilitate cleansing of the substrate with water.

        185. A coating composition for use in forming a  
35 photocatalytically hydrophilifiable coating on a substrate,

said coating composition comprising:

a suspension comprising particles of photocatalytic titania and particles of tin oxide;

said coating composition being capable of forming a  
5 photo-reactive coating comprised of sintered particles of photocatalytic titania and tin oxide upon application on the substrate followed by sintering;

said photocatalytic titania rendering upon  
photoexcitation the surface of said coating hydrophilic whereby  
10 adherent moisture condensate and/or water droplets are caused to spread over the surface of the coating to thereby prevent growth of water droplets.

186. A coating composition for use in forming a  
15 photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a suspension comprising particles of photocatalytic titania and particles of tin oxide;

said coating composition being capable of forming a  
20 photo-reactive coating comprised of sintered particles of photocatalytic titania and tin oxide upon application on the substrate followed by sintering;

said photocatalytic titania rendering upon  
photoexcitation the surface of said coating hydrophilic whereby  
25 adherent water droplets are caused to spread over the surface of the coating to thereby promote drying of the substrate after wetted with water.

187. A coating composition for use in forming a  
30 photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a film-forming element comprising a precursor of amorphous titania and capable of forming a coating of photocatalytic titania upon curing and calcination; and,

35 particles of tin oxide dispersed in said film-forming

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element;

upon application on the substrate followed by calcination said coating composition being capable of forming a photo-reactive coating of photocatalytic titania in which

5 particles of tin oxide are dispersed;

said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic on the order of less than about  $10^\circ$  in terms of the contact angle with water.

10

188. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

15 a film-forming element comprising a precursor of amorphous titania and capable of forming a coating of photocatalytic titania upon curing and calcination; and, particles of tin oxide dispersed in said film-forming element;

20 upon application on the substrate followed by calcination said coating composition being capable of forming a photo-reactive coating of photocatalytic titania in which particles of tin oxide are dispersed;

25 said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said coating to thereby prevent the substrate from being fogged or blurred with adherent moisture condensate and/or water droplets.

30 189. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

35 a film-forming element comprising a precursor of amorphous titania and capable of forming a coating of photocatalytic titania upon curing and calcination; and,

particles of tin oxide dispersed in said film-forming element;

upon application on the substrate followed by calcination said coating composition being capable of forming a photo-reactive coating of photocatalytic titania in which particles of tin oxide are dispersed;

said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic whereby adherent deposits and/or contaminants are away by rainwater as said substrate is subjected to rainfall to thereby permit self-cleaning of the substrate.

190. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a film-forming element comprising a precursor of amorphous titania and capable of forming a coating of photocatalytic titania upon curing and calcination; and, particles of tin oxide dispersed in said film-forming element;

upon application on the substrate followed by calcination said coating composition being capable of forming a photo-reactive coating of photocatalytic titania in which particles of tin oxide are dispersed;

said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic whereby contaminants are prevented from adhering to the surface of the substrate as contaminant-laden rainwater flows therealong.

191. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a film-forming element comprising a precursor of amorphous titania and capable of forming a coating of photocatalytic titania upon curing and calcination; and,

particles of tin oxide dispersed in said film-forming element;

upon application on the substrate followed by calcination said coating composition being capable of forming a photo-reactive coating of photocatalytic titania in which particles of tin oxide are dispersed;

said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic whereby deposits and/or contaminants adhering to the surface are released therefrom when soaked in or wetted with water to thereby facilitate cleansing of the substrate with water.

192. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a film-forming element comprising a precursor of amorphous titania and capable of forming a coating of photocatalytic titania upon curing and calcination; and, particles of tin oxide dispersed in said film-forming element;

upon application on the substrate followed by calcination said coating composition being capable of forming a photo-reactive coating of photocatalytic titania in which particles of tin oxide are dispersed;

said photocatalytic titania rendering upon photoexcitation the surface of said coating hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of the coating to thereby prevent growth of water droplets.

193. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a film-forming element comprising a precursor of amorphous titania and capable of forming a coating of

photocatalytic titania upon curing and calcination; and,  
particles of tin oxide dispersed in said film-forming  
element;

upon application on the substrate followed by  
5 calcination said coating composition being capable of forming a  
photo-reactive coating of photocatalytic titania in which  
particles of tin oxide are dispersed;

said photocatalytic titania rendering upon  
photoexcitation the surface of said coating hydrophilic whereby  
10 adherent water droplets are caused to spread over the surface  
of the coating to thereby promote drying of the substrate after  
wetted with water.

194. A coating composition for use in forming a  
15 photocatalytically hydrophilifiable coating on a substrate,  
said coating composition comprising:

a film-forming element comprising uncured or  
partially cured silicone or a precursor thereof and capable of  
forming a coating of silicone when cured; and,

20 particles of photocatalytic titania dispersed in said  
film-forming element for causing upon photoexcitation the  
organic groups bonded to the silicon atoms of the silicone  
molecules at the surface of the coating to be substituted at  
least in part with hydroxyl groups in the presence of water  
25 under the photocatalytic action to thereby render the surface  
of said coating hydrophilic on the order of less than about 10°  
in terms of the contact angle with water.

195. A coating composition according to claim 194, wherein  
30 said particles of photocatalytic titania are operable upon  
photoexcitation to render the surface of said coating  
hydrophilic on the order of less than about 5° in terms of the  
contact angle with water.

35 196. A coating composition for use in forming a

photocatalytically hydrophilifiable coating on a substrate,  
said coating composition comprising:

- 5 a film-forming element comprising uncured or  
partially cured silicone or a precursor thereof and capable of  
forming a coating of silicone when cured; and,  
particles of photocatalytic titania dispersed in said  
film-forming element for causing upon photoexcitation the  
organic groups bonded to the silicon atoms of the silicone  
molecules at the surface of the coating to be substituted at  
10 least in part with hydroxyl groups in the presence of water  
under the photocatalytic action to thereby render the surface  
of said coating hydrophilic whereby adherent moisture  
condensate and/or water droplets are caused to spread over the  
surface of said coating to thereby prevent the substrate from  
15 being fogged or blurred with adherent moisture condensate  
and/or water droplets.

197. A coating composition for use in forming a  
photocatalytically hydrophilifiable coating on a substrate,  
20 said coating composition comprising:

- a film-forming element comprising uncured or  
partially cured silicone or a precursor thereof and capable of  
forming a coating of silicone when cured; and,  
particles of photocatalytic titania dispersed in said  
25 film-forming element for causing upon photoexcitation the  
organic groups bonded to the silicon atoms of the silicone  
molecules at the surface of the coating to be substituted at  
least in part with hydroxyl groups in the presence of water  
under the photocatalytic action to thereby render the surface  
30 of said coating hydrophilic whereby adherent deposits and/or  
contaminants are away by rainwater as said substrate is  
subjected to rainfall to thereby permit self-cleaning of the  
substrate.

- 35 198. A coating composition for use in forming a



photocatalytically hydrophilifiable coating on a substrate,  
said coating composition comprising:

- 5 a film-forming element comprising uncured or  
partially cured silicone or a precursor thereof and capable of  
forming a coating of silicone when cured; and,  
particles of photocatalytic titania dispersed in said  
film-forming element for causing upon photoexcitation the  
organic groups bonded to the silicon atoms of the silicone  
molecules at the surface of the coating to be substituted at  
10 least in part with hydroxyl groups in the presence of water  
under the photocatalytic action to thereby render the surface  
of said coating hydrophilic whereby contaminants are prevented  
from adhering to the surface of the substrate as contaminant-  
laden rainwater flows therealong.

15

199. A coating composition for use in forming a  
photocatalytically hydrophilifiable coating on a substrate,  
said coating composition comprising:

- 20 a film-forming element comprising uncured or  
partially cured silicone or a precursor thereof and capable of  
forming a coating of silicone when cured; and,  
particles of photocatalytic titania dispersed in said  
film-forming element for causing upon photoexcitation the  
organic groups bonded to the silicon atoms of the silicone  
25 molecules at the surface of the coating to be substituted at  
least in part with hydroxyl groups in the presence of water  
under the photocatalytic action to thereby render the surface  
of said coating hydrophilic whereby deposits and/or  
contaminants adhering to the surface are released therefrom  
30 when soaked in or wetted with water to thereby facilitate  
cleansing of the substrate with water.

200. A coating composition for use in forming a  
photocatalytically hydrophilifiable coating on a substrate,  
35 said coating composition comprising:

a film-forming element comprising uncured or partially cured silicone or a precursor thereof and capable of forming a coating of silicone when cured; and, particles of photocatalytic titania dispersed in said film-forming element for causing upon photoexcitation the organic groups bonded to the silicon atoms of the silicone molecules at the surface of the coating to be substituted at least in part with hydroxyl groups in the presence of water under the photocatalytic action to thereby render the surface of said coating hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of the coating to thereby prevent growth of water droplets.

201. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising:

a film-forming element comprising uncured or partially cured silicone or a precursor thereof and capable of forming a coating of silicone when cured; and, particles of photocatalytic titania dispersed in said film-forming element for causing upon photoexcitation the organic groups bonded to the silicon atoms of the silicone molecules at the surface of the coating to be substituted at least in part with hydroxyl groups in the presence of water under the photocatalytic action to thereby render the surface of said coating hydrophilic whereby adherent water droplets are caused to spread over the surface of the coating to thereby promote drying of the substrate after wetted with water.

202. A method for rendering a surface of a substrate hydrophilic, comprising the steps of:

(a) preparing a substrate coated with a layer of silicone in which particles of a photocatalyst are uniformly dispersed;

(b) subjecting said photocatalyst to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said layer are substituted at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst to thereby render the surface of said layer hydrophilic.

203. A method for rendering a surface of a substrate hydrophilic, comprising the steps of:

10 (a) preparing a substrate coated with a layer of silicone in which particles of a photocatalyst are uniformly dispersed;

(b) subjecting said photocatalyst to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said layer are substituted at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst to thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than about  $10^\circ$  in terms of the contact angle with water.

204. An antifogging method for preventing a transparent sheet member from being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

(a) preparing a transparent sheet member coated with a substantially transparent layer of silicone in which particles of a photocatalyst are uniformly dispersed; and,

(b) subjecting said photocatalyst of said layer to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said layer are substituted at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst to thereby render the surface of said layer hydrophilic whereby adherent moisture condensate and/or water droplets are caused

to spread over the surface of said layer.

205. An antifogging method for preventing a lens from being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

(a) preparing a lens coated with a substantially transparent layer of silicone in which particles of a photocatalyst are uniformly dispersed; and,

(b) subjecting said photocatalyst of said layer to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said layer are substituted at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst to thereby render the surface of said layer hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer.

206. An antifogging method for preventing a mirror from being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

(a) preparing a mirror coated with a substantially transparent layer of silicone in which particles of a photocatalyst are uniformly dispersed; and,

(b) subjecting said photocatalyst of said layer to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said layer are substituted at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst to thereby render the surface of said layer hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer.

207. A method for cleaning a substrate, comprising the steps of:

(a) preparing a substrate coated with a layer of

silicone in which particles of a photocatalyst are uniformly dispersed;

(b) disposing said substrate outdoors;

(c) subjecting said photocatalyst of said layer to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said layer are substituted at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst whereby the surface of said layer is rendered hydrophilic; and,

(d) subjecting said substrate to rainfall whereby deposits and/or contaminants adhering on the surface of said layer are washed away by rainwater.

208. A method for cleaning a substrate, comprising the steps of:

(a) preparing a substrate coated with a layer of silicone in which particles of a photocatalyst are uniformly dispersed;

(b) subjecting said photocatalyst of said layer to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said layer are substituted at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst whereby the surface of said layer is rendered hydrophilic; and,

(c) rinsing said substrate with water whereby organic deposits and/or contaminants adhering on the surface of said layer are released therefrom and washed away by water.

209. A method for cleaning a substrate, comprising the steps of:

(a) preparing a substrate coated with a layer of silicone in which particles of a photocatalyst are uniformly dispersed;

(b) subjecting said photocatalyst of said layer to photoexcitation so that the organic groups bonded to the

silicon atoms of the silicone molecules at the surface of said layer are substituted at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst whereby the surface of said layer is rendered hydrophilic; and,

- 5 (c) causing said substrate soaked in or wetted with water whereby organic deposits and/or contaminants adhering on the surface of said layer are released therefrom.

210. A method for maintaining a surface of a substrate  
10 disposed outdoors clean, comprising the steps of:

(a) preparing a substrate coated with a layer of silicone in which particles of a photocatalyst are uniformly dispersed;

(b) disposing said substrate outdoors; and,

- 15 (c) subjecting said photocatalyst of said layer to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said layer are substituted at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst to  
20 thereby render the surface of said layer hydrophilic whereby contaminants are prevented from adhering to the surface of said substrate as contaminant-laden rainwater flows therealong.

211. A method for preventing growth of water droplets  
25 adhering on a substrate, comprising the steps of:

(a) preparing a substrate coated with a layer of silicone in which particles of a photocatalyst are uniformly dispersed;

- (b) subjecting said photocatalyst of said layer to  
30 photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said layer are substituted at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst whereby the surface of said layer is rendered hydrophilic; and,

- 35 (c) causing adherent moisture condensate and/or water

droplets to spread over the surface of said layer.

212. A method for rendering a surface of a substrate hydrophilic, comprising the steps of:

- 5 (a) applying onto the surface of said substrate a coating composition comprising particles of photocatalyst and a film-forming element of uncured or partially cured silicone or a precursor thereof;
- 10 (b) curing said film-forming element to form a silicone coating in which particles of the photocatalyst are uniformly dispersed; and,
- 15 (c) subjecting said photocatalyst to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said coating are substituted at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst to thereby render the surface of the coating hydrophilic.

213. A method according to claim 212, wherein said  
20 photocatalyst is photoexcited until the surface of said coating presents a water-wettability of less than about  $10^\circ$  in terms of the contact angle with water.

214. An antifogging method for preventing a transparent  
25 sheet member from being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

- (a) preparing a transparent sheet member;
- 30 (b) applying onto the surface of said sheet member a coating composition comprising particles of photocatalyst and a film-forming element of uncured or partially cured silicone or a precursor thereof;
- (c) curing said film-forming element to form a substantially transparent silicone coating in which particles  
35 of the photocatalyst are uniformly dispersed; and,

(d) subjecting said photocatalyst to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said coating are substituted at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst to thereby render the surface of the coating hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of the coating.

215. An antifogging method for preventing a lens from being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

- (a) preparing a lens;
- (b) applying onto the surface of the lens a coating composition comprising particles of photocatalyst and a film-forming element of uncured or partially cured silicone or a precursor thereof;
- (c) curing said film-forming element to form a substantially transparent silicone coating in which particles of the photocatalyst are uniformly dispersed; and,
- (d) subjecting said photocatalyst to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said coating are substituted at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst to thereby render the surface of the coating hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of the coating.

216. An antifogging method for preventing a mirror from being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

- (a) preparing a mirror;
- (b) applying onto the surface of the mirror a coating composition comprising particles of photocatalyst and a film-



forming element of uncured or partially cured silicone or a precursor thereof;

(c) curing said film-forming element to form a substantially transparent silicone coating in which particles  
5 of the photocatalyst are uniformly dispersed; and,

(d) subjecting said photocatalyst to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said coating are substituted at least in part with hydroxyl groups under the  
10 photocatalytic action of said photocatalyst to thereby render the surface of the coating hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of the coating.

15 217. A method for cleaning a substrate, comprising the steps of:

(a) preparing a substrate;

(b) applying onto the surface of the substrate a coating composition comprising particles of photocatalyst and a  
20 film-forming element of uncured or partially cured silicone or a precursor thereof;

(c) curing said film-forming element to form a silicone coating in which particles of the photocatalyst are uniformly dispersed;

25 (d) disposing said substrate outdoors;

(e) subjecting said photocatalyst to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said coating are substituted at least in part with hydroxyl groups under the  
30 photocatalytic action of said photocatalyst to thereby render the surface of the coating hydrophilic; and,

(f) subjecting said substrate to rainfall to thereby permit deposits and/or contaminants adhering on the surface of said layer to be washed away by rainwater.

218. A method for cleaning a substrate, comprising the steps of:

- (a) preparing a substrate;
- (b) applying onto the surface of said substrate a coating composition comprising particles of photocatalyst and a film-forming element of uncured or partially cured silicone or a precursor thereof;
- (c) curing said film-forming element to form a silicone coating in which particles of the photocatalyst are uniformly dispersed;
- (d) subjecting said photocatalyst to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said coating are substituted at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst to thereby render the surface of the coating hydrophilic; and,
- (e) rinsing said substrate with water to thereby permit organic deposits and/or contaminants adhering on the surface of said coating to be released therefrom and washed away by water.

219. A method for cleaning a substrate, comprising the steps of:

- (a) preparing a substrate;
- (b) applying onto the surface of said substrate a coating composition comprising particles of photocatalyst and a film-forming element of uncured or partially cured silicone or a precursor thereof;
- (c) curing said film-forming element to form a silicone coating in which particles of the photocatalyst are uniformly dispersed;
- (d) subjecting said photocatalyst to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said coating are substituted at least in part with hydroxyl groups under the

photocatalytic action of said photocatalyst to thereby render the surface of the coating hydrophilic; and,

- (e) causing said substrate soaked in or wetted with water to thereby permit organic deposits and/or contaminants adhering on the surface of the coating to be released therefrom.

220. A method for maintaining a surface of a substrate disposed outdoors clean, comprising the steps of:

- (a) preparing a substrate;
- (b) applying onto the surface of the substrate a coating composition comprising particles of photocatalyst and a film-forming element of uncured or partially cured silicone or a precursor thereof;
- (c) curing said film-forming element to form a silicone coating in which particles of the photocatalyst are uniformly dispersed;
- (d) disposing said substrate outdoors; and,
- (e) subjecting said photocatalyst to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said coating are substituted at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst to thereby render the surface of the coating hydrophilic whereby contaminants are prevented from adhering to the surface of said substrate as contaminant-laden rainwater flows therealong.

221. A method for preventing growth of water droplets adhering on a substrate, comprising the steps of:

- (a) preparing a substrate;
- (b) applying onto the surface of said substrate a coating composition comprising particles of photocatalyst and a film-forming element of uncured or partially cured silicone or a precursor thereof;
- (c) curing said film-forming element to form a

silicone coating in which particles of the photocatalyst are uniformly dispersed;

(d) subjecting said photocatalyst to photoexcitation so that the organic groups bonded to the silicon atoms of the silicone molecules at the surface of said coating are substituted at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst to thereby render the surface of the coating hydrophilic; and,

(e) causing adherent moisture condensate and/or water droplets to spread over the surface of said coating.

222. A composite with a hydrophilic surface, comprising:

a substrate having a surface; and,

a photocatalytic layer comprised of a photocatalyst, said photocatalytic layer being bonded to the surface of said substrate;

said photocatalyst operating upon photoexcitation thereof to render the surface of said layer hydrophilic such that the surface presents a water wettability of less than about  $10^\circ$  in terms of the contact angle with water.

223. An antifogging transparent sheet member comprising:

a transparent substrate; and,

a substantially transparent layer comprised of a photocatalyst and bonded to the surface of said substrate;

said photocatalyst operating upon photoexcitation thereof to render the surface of said layer hydrophilic such that the surface of said layer presents a water-wettability of less than about  $10^\circ$  in terms of the contact angle with water whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer to thereby prevent the substrate from being fogged or blurred with adherent moisture condensate and/or water droplets.

224. An antifogging mirror comprising:

a substrate with a reflective coating; and,  
a substantially transparent layer comprised of a  
photocatalyst and bonded to the surface of said substrate;  
said photocatalyst operating upon photoexcitation  
5 thereof to render the surface of said layer hydrophilic such  
that the surface of said layer presents a water-wettability of  
less than about  $10^\circ$  in terms of the contact angle with water  
whereby adherent moisture condensate and/or water droplets are  
caused to spread over the surface of said layer to thereby  
10 prevent the substrate from being fogged or blurred with  
adherent moisture condensate and/or water droplets.

225. An antifogging lens comprising:  
a transparent lens-forming body; and,  
15 a substantially transparent layer comprised of a  
photocatalyst and bonded to the surface of said lens-forming  
body;  
said photocatalyst operating upon photoexcitation  
thereof to render the surface of said layer hydrophilic such  
20 that the surface of said layer presents a water-wettability of  
less than about  $10^\circ$  in terms of the contact angle with water  
whereby adherent moisture condensate and/or water droplets are  
caused to spread over the surface of said layer to thereby  
prevent the lens-forming body from being fogged or blurred with  
25 adherent moisture condensate and/or water droplets.

226. A composite according to claim 222, wherein, for  
self-cleaning of the composite, said layer operates to permit  
adherent deposits and/or contaminants to be washed away by  
30 rainwater as said composite is subjected to rainfall.

227. A composite according to claim 222, wherein said  
layer operates to prevent contaminants from adhering to the  
surface thereof as contaminant-laden rainwater flows  
therealong.

228. A composite according to claim 222, wherein, to facilitate cleansing of the composite with water, said layer operates to release adherent deposits and/or contaminants when soaked in or wetted with water.

5

229. A composite according to claim 222, wherein, for prevention of growth of water droplets, said layer operates to cause adherent moisture condensate and/or water droplets to spread over the surface of said layer.

10

230. A composite according to claim 222, wherein, to promote drying of the substrate after wetted with water, said layer operates to cause adherent water droplets to spread over the surface of said layer.

15

231. A composite according to claim 222, wherein the surface of said layer is further coated with a hydrophilic protective layer which is operable to present upon photoexcitation a water-wettability of less than about  $10^\circ$  in terms of the contact angle with water.

20

232. A composite according to claim 222, wherein the surface of said layer is further coated with a hydrophilifiable protective layer which is operable to present upon photoexcitation a water-wettability of less than about  $10^\circ$  in terms of the contact angle with water.

25

233. A composite according to claim 222, wherein said photocatalyst comprises an oxide selected from the group consisting of  $\text{TiO}_2$ ,  $\text{ZnO}$ ,  $\text{SnO}_2$ ,  $\text{SrTiO}_3$ ,  $\text{WO}_3$ ,  $\text{Bi}_2\text{O}_3$  and  $\text{Fe}_2\text{O}_3$ .

30

234. A composite according to claim 222, wherein said photocatalyst comprises the anatase form of titania.

235. A composite according to claim 222, wherein said photocatalyst comprises the rutile form of titania.

236. A composite according to claim 222, wherein said layer further comprises  $\text{SiO}_2$  or  $\text{SnO}_2$ .

5

237. A composite according to claim 222, wherein said layer comprises a coating wherein particles of said photocatalyst are uniformly dispersed.

10

238. A composite according to claim 222, wherein said layer is made of a coating containing silicone and wherein the surface of said coating is formed of a derivative of silicone in which the organic groups bonded to the silicon atoms of the silicone molecules have been substituted upon photoexcitation at least in part with hydroxyl groups under the photocatalytic action of said photocatalyst.

15

239. A composite according to claim 222, further comprising an intermediate layer of a non-decomposable material interleaved between said substrate and said layer of photocatalyst.

20

240. A composite according to claim 222, wherein said substrate contains alkaline metal ions and/or alkaline-earth metal ions and wherein a thin film for preventing said ions from diffusing from said substrate into said layer is interleaved between said substrate and said layer.

25

241. A composite according to claim 240, wherein said thin film comprises a thin film of silica.

30

242. A composite according to claim 222, wherein the thickness of said layer is less than about 0.2 micrometers.

243. A composite according to claim 222, wherein said layer further comprises a metal selected from the group consisting of Ag, Cu and Zn.

5        244. A composite according to claim 222, wherein said layer further comprises a metal selected from the group consisting of Pt, Pd, Rh, Ru, Os and Ir.

245. A method for rendering a surface of a substrate  
10 hydrophilic, comprising the steps of:  
      preparing a substrate coated with a layer comprised of a photocatalyst; and,  
      subjecting said photocatalyst to photoexcitation until the surface of said layer presents a water-wettability of  
15 less than about 10° in terms of the contact angle with water.

246. An antifogging method for preventing a transparent sheet member from being fogged or blurred with adherent moisture condensate and/or water droplets, said method  
20 comprising the steps of:  
      preparing a transparent sheet member coated with a substantially transparent layer comprised of a photocatalyst; and,  
      subjecting said photocatalyst to photoexcitation to  
25 thereby render the surface of said layer hydrophilic until the water wettability of said layer becomes less than about 10° in terms of the contact angle with water whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer.

30        247. An antifogging method for preventing a mirror from being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:  
      preparing a mirror coated with a substantially  
35 transparent layer comprised of a photocatalyst; and,



subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the water wettability of said layer becomes less than about  $10^\circ$  in terms of the contact angle with water whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer.

248. An antifogging method for preventing a lens from being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

preparing a lens coated with a substantially transparent layer comprised of a photocatalyst; and,

subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the water wettability of said layer becomes less than about  $10^\circ$  in terms of the contact angle with water whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer.

249. A method for cleaning a substrate, comprising the steps of:

preparing a substrate coated with a layer comprised of a photocatalyst;

disposing said substrate outdoors;

subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the water wettability of said layer becomes less than about  $10^\circ$  in terms of the contact angle with water; and,

subjecting said substrate to rainfall whereby deposits and/or contaminants adhering on the surface of said layer are washed away by rainwater.

250. A method for cleaning a substrate, comprising the steps of:

preparing a substrate coated with a layer comprised

of a photocatalyst;

subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the water wettability of said layer becomes less than about 10° in terms of the contact angle with water; and,

rinsing said substrate with water whereby organic deposits and/or contaminants adhering on the surface of said layer are released therefrom and washed away by water.

251. A method for cleaning a substrate, comprising the steps of:

preparing a substrate coated with a layer comprised of a photocatalyst;

subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the water wettability of said layer becomes less than about 10° in terms of the contact angle with water; and,

causing said substrate soaked in or wetted with water whereby organic deposits and/or contaminants adhering on the surface of said layer are released therefrom.

252. A method for maintaining a surface of a substrate disposed outdoors clean, comprising the steps of:

preparing a substrate coated with a layer comprised of a photocatalyst;

disposing said substrate outdoors; and,

subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the water wettability of said layer becomes less than about 10° in terms of the contact angle with water whereby contaminants are prevented from adhering to the surface of said substrate as contaminant-laden rainwater flows therealong.

253. A method for preventing growth of water droplets adhering on a substrate, comprising the steps of:

preparing a substrate coated with a layer comprised of a photocatalyst;

subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the water wettability of said layer becomes less than about 10° in terms of the contact angle with water; and,

causing adherent moisture condensate and/or water droplets to spread over the surface of said layer.

254. A method according to one of claims 245-253, wherein the step of subjecting said photocatalyst to photoexcitation is carried out with the sunlight.

255. A method according to one of claims 245-253, wherein the step of subjecting said photocatalyst to photoexcitation is carried out with an electric lamp selected from the group consisting of fluorescent lamp, incandescent lamp, metal halide lamp, and mercury lamp.

256. A method for rendering a surface of a substrate hydrophilic, comprising the steps of:

coating the surface of the substrate with a layer comprised of a photocatalyst; and,

subjecting said photocatalyst to photoexcitation until the surface of said layer presents a water-wettability of less than about 10° in terms of the contact angle with water.

257. An antifogging method for preventing a transparent sheet member from being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

preparing a transparent sheet member;

coating the surface of said transparent sheet member with a substantially transparent layer comprised of a photocatalyst; and,

subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than about 10° in terms of the contact angle with water whereby  
5 adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer.

258. An antifogging method for preventing a mirror from being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

preparing a mirror;

coating the surface of said mirror with a substantially transparent layer comprised of a photocatalyst; and,

15 subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than about 10° in terms of the contact angle with water whereby adherent moisture condensate and/or water droplets are caused  
20 to spread over the surface of said layer.

259. An antifogging method for preventing a lens from being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

25 preparing a lens;

coating the surface of said lens with a substantially transparent layer comprised of a photocatalyst; and,

subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the  
30 surface of said layer presents a water-wettability of less than about 10° in terms of the contact angle with water whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer.

35 260. A method for cleaning a substrate, comprising the

steps of:

- preparing a substrate;
- coating the surface of said substrate with a layer comprised of a photocatalyst;
- 5 disposing said substrate outdoors;
- subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than about 10° in terms of the contact angle with water; and,
- 10 subjecting said substrate to rainfall whereby deposits and/or contaminants adhering on the surface of said layer are washed away by rainwater.

261. A method for cleaning a substrate, comprising the steps of:

- preparing a substrate;
- coating the surface of said substrate with a layer comprised of a photocatalyst;
- subjecting said photocatalyst to photoexcitation to
- 20 thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than about 10° in terms of the contact angle with water; and,
- rinsing said substrate with water whereby organic deposits and/or contaminants adhering on the surface of said
- 25 layer are released therefrom and washed away by water.

262. A method for cleaning a substrate, comprising the steps of:

- preparing a substrate;
- 30 coating the surface of said substrate with a layer comprised of a photocatalyst;
- subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than
- 35 about 10° in terms of the contact angle with water; and,

causing said substrate soaked in or wetted with water whereby organic deposits and/or contaminants adhering on the surface of said layer are released therefrom.

- 5           263. A method for maintaining a surface of a substrate disposed outdoors clean, comprising the steps of:
- preparing a substrate;
  - coating the surface of said substrate with a layer comprised of a photocatalyst;
  - 10           disposing said substrate outdoors; and,
  - subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the surface of said layer presents a water-wettability of less than about 10° in terms of the contact angle with water whereby
  - 15           contaminants are prevented from adhering to the surface of said substrate as contaminant-laden rainwater flows therealong.

264. A method for preventing growth of water droplets adhering on a substrate, comprising the steps of:
- 20           preparing a substrate;
  - coating the surface of said substrate with a layer comprised of a photocatalyst;
  - subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic until the
  - 25           surface of said layer presents a water-wettability of less than about 10° in terms of the contact angle with water; and,
  - causing adherent moisture condensate and/or water droplets to spread over the surface of said layer.

          265. A method according to one of claims 256-264, wherein the step of subjecting said photocatalyst to photoexcitation is carried out with the sunlight.

- 30           266. A method according to one of claims 256-264, wherein the step of subjecting said photocatalyst to photoexcitation is

carried out with an electric lamp selected from the group consisting of fluorescent lamp, incandescent lamp, metal halide lamp, and mercury lamp.

5        267. A method of manufacturing a composite with a hydrophilic surface, comprising the steps of:  
         preparing a substrate having a surface;  
         coating the surface of said substrate with a photo-  
         reactive layer comprised of a photocatalyst and operable to  
10       present upon photoexcitation a water wettability of less than about 10° in terms of the contact angle with water; and,  
         subjecting said photocatalyst to photoexcitation until the water wettability of said layer becomes less than about 10° in terms of the contact angle with water.

15       268. A method of manufacturing an antifogging transparent sheet member, comprising the steps of:  
         preparing a transparent substrate having a surface;  
         coating the surface of said substrate with a  
20       substantially transparent photo-reactive layer comprised of a photocatalyst and operable to present upon photoexcitation a water wettability of less than about 10° in terms of the contact angle with water; and,  
         subjecting said photocatalyst to photoexcitation  
25       until the water wettability of said layer becomes less than about 10° in terms of the contact angle with water.

         269. A method of manufacturing a self-cleaning composite, comprising the steps of:  
30       preparing a substrate having a surface;  
         coating the surface of said substrate with a photo-  
         reactive layer comprised of a photocatalyst and operable to  
         present upon photoexcitation a water wettability of less than  
         about 10° in terms of the contact angle with water; and,  
35       subjecting said photocatalyst to photoexcitation

until the water wettability of said layer becomes less than about 10° in terms of the contact angle with water.

270. A method of manufacturing an antifogging mirror,  
5 comprising the steps of:

preparing a substrate with or without a reflective coating, said substrate having a surface;

coating the surface of said substrate with a substantially transparent photo-reactive layer comprised of a photocatalyst and operable to present upon photoexcitation a  
10 water wettability of less than about 10° in terms of the contact angle with water;

forming where necessary a reflective coating on the opposite surface of said substrate prior to or subsequent to or  
15 during the course of said step of coating; and,

subjecting said photocatalyst to photoexcitation until the water wettability of said layer becomes less than about 10° in terms of the contact angle with water.

271. A method of manufacturing an antifogging lens,  
20 comprising the steps of:

preparing a lens-forming body having a surface;

coating the surface of said body with a substantially transparent photo-reactive layer comprised of a photocatalyst  
25 and operable to present upon photoexcitation a water wettability of less than about 10° in terms of the contact angle with water; and,

subjecting said photocatalyst to photoexcitation until the water wettability of said layer becomes less than  
30 about 10° in terms of the contact angle with water.

272. A method according to one of claims 267-271, wherein said step of coating comprises the substeps of:

(a) coating the surface with a thin film of amorphous  
35 titania; and,



(b) heating said thin film at a temperature less than the softening point of the substrate to transform amorphous titania into crystalline titania.

5        273. A method according to claim 272, wherein prior to said step of coating the substrate is coated with a thin film of silica to prevent alkaline network-modifier ions from diffusing from the substrate into said photo-reactive layer.

10       274. A method according to claim 272, wherein said step (a) is carried out by applying onto the surface a solution of an organic compound of titanium, followed by subjecting said compound to hydrolysis and dehydration polymerization to form said thin film of amorphous titania over the surface.

15       275. A method according to claim 274, wherein said organic compound of titanium is selected from the group consisting of an alkoxide of titanium, a chelate of titanium and an acetate of titanium.

20       276. A method according to claim 272, wherein said step (a) is carried out by applying onto the surface a solution of an inorganic compound of titanium, followed by subjecting said compound to hydrolysis and dehydration polymerization to form said thin film of amorphous titania over the surface.

277. A method according to claim 276, wherein said inorganic compound of titanium is  $\text{TiCl}_4$  or  $\text{Ti}(\text{SO}_4)_2$ .

30       278. A method according to claim 272, wherein said step (a) is carried out by sputtering.

35       279. A coating composition for use in forming a photocatalytically hydrophilifiable coating on a substrate, said coating composition comprising a photocatalyst operable

upon photoexcitation thereof to render the surface of said coating hydrophilic on the order of less than about  $10^\circ$  in terms of the contact angle with water.

5        280. A coating composition according to claim 279, wherein  
the surface of said coating thus rendered hydrophilic upon  
photoexcitation is operable to permit adherent moisture  
condensate and/or water droplets to spread thereover to thereby  
prevent the substrate from being fogged or blurred with  
10    adherent moisture condensate and/or water droplets.

281. A coating composition according to claim 279, wherein  
the surface of said coating thus rendered hydrophilic upon  
photoexcitation is operable to permit adherent deposits and/or  
15    contaminants to be washed away by rainwater as the substrate is  
subjected to rainfall whereby the surface is self-cleaned.

282. A coating composition according to claim 279, wherein  
the surface of said coating thus rendered hydrophilic upon  
20    photoexcitation is operable to prevent contaminants from  
adhering to the surface as contaminant-laden rainwater flows  
therealong.

283. A coating composition according to claim 279, wherein  
the surface of said coating thus rendered hydrophilic upon  
25    photoexcitation is operable to release adherent deposits and/or  
contaminants when soaked in or wetted with water to thereby  
facilitate cleansing of the substrate with water.

284. A coating composition according to claim 279, wherein  
30    the surface of said coating thus rendered hydrophilic upon  
photoexcitation is operable to permit adherent moisture  
condensate and/or water droplets to spread thereover to thereby  
prevent growth of water droplets.

285. A coating composition according to claim 279, wherein the surface of said coating thus rendered hydrophilic upon photoexcitation is operable to permit adherent moisture condensate and/or water droplets to spread thereover to thereby promote drying of the substrate after wetted with water.

286. An antifogging transparent sheet member comprising:  
a transparent substrate; and,  
a substantially transparent layer comprised of a photocatalyst and bonded to the surface of said substrate;  
said photocatalyst operating upon photoexcitation thereof to render the surface of said layer hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer to thereby prevent the substrate from being fogged or blurred with adherent moisture condensate and/or water droplets.

287. An antifogging mirror comprising:  
a substrate with a reflective coating; and,  
a substantially transparent layer comprised of a photocatalytic semiconductor material and bonded to the surface of said substrate;  
said photocatalytic material operating upon photoexcitation thereof to render the surface of said layer hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer to thereby prevent the substrate from being fogged or blurred with adherent moisture condensate and/or water droplets.

288. An antifogging mirror according to claim 287, wherein said mirror is a rearview mirror for a vehicle.

289. An antifogging lens comprising:  
a transparent lens-forming body; and,  
a substantially transparent layer comprised of a

photocatalyst and bonded to the surface of said lens-forming body;

5       said photocatalyst operating upon photoexcitation thereof to render the surface of said layer hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer to thereby prevent the lens-forming body from being fogged or blurred with adherent moisture condensate and/or water droplets.

10       290. An antifogging method for preventing a mirror from being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

15             preparing a mirror coated with a substantially transparent layer comprised of a photocatalyst; and, subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer.

20       291. An antifogging method for preventing a lens from being fogged or blurred with adherent moisture condensate and/or water droplets, said method comprising the steps of:

25             preparing a lens coated with a substantially transparent layer comprised of a photocatalyst; and, subjecting said photocatalyst to photoexcitation to thereby render the surface of said layer hydrophilic whereby adherent moisture condensate and/or water droplets are caused to spread over the surface of said layer.

30       292. A composite with a hydrophilic surface, comprising: a substrate having a surface; and, a photocatalytic layer comprised of a photocatalyst, said photocatalytic layer being bonded to the surface of said substrate;

35             said photocatalyst operating upon photoexcitation

thereof to render the surface of said layer hydrophilic to permit adherent deposits and/or contaminants to be washed away by rainwater to thereby self-clean the composite as said composite is subjected to rainfall.

5

293. A composite with a hydrophilic surface, comprising:  
a substrate having a surface; and,  
a photocatalytic layer comprised of a photocatalyst,  
said photocatalytic layer being bonded to the surface of said  
10 substrate;

said photocatalyst operating upon photoexcitation thereof to render the surface of said layer hydrophilic to thereby prevent contaminants from adhering to the surface thereof as contaminant-laden rainwater flows therealong.

15

294. A composite according to claim 292 or 293, wherein said substrate is a building material.

20

295. A composite with a hydrophilic surface, comprising:  
a substrate; and,  
a layer comprised of a photocatalyst and bonded to  
the surface of said substrate;

25

said photocatalyst operating upon photoexcitation thereof to render the surface of said layer hydrophilic to permit adherent deposits and/or contaminants to be released when soaked in or wetted with water to thereby facilitate cleansing of the substrate with water.

30

296. A composite with a hydrophilic surface, comprising:  
a substrate; and,  
a layer comprised of a photocatalyst and bonded to  
the surface of said substrate;

35

said photocatalyst operating upon photoexcitation thereof to render the surface of said layer hydrophilic to permit adherent moisture condensate and/or water droplets to

spread thereover to thereby prevent growth of water droplets.

297. A composite according to claim 296, wherein said substrate is a radiator fin for a heat exchanger and wherein  
5 said layer permits adherent moisture condensate and/or water droplets to spread into water film to thereby increase the efficiency of the heat exchanger.

298. A composite with a hydrophilic surface, comprising:  
10 a substrate; and,  
a layer comprised of a photocatalyst and bonded to the surface of said substrate;  
said photocatalyst operating upon photoexcitation thereof to render the surface of said layer hydrophilic to  
15 permit adherent moisture condensate and/or water droplets to spread thereover to thereby promote drying of the substrate after wetted with water.

299. A composite according to claim 298, wherein said  
20 substrate is a surface of an article selected from the group consisting of mirror, lens, sheet glass, and windshield.

300. A composite according to claim 298, wherein said  
25 substrate is a surface of a pavement.

add  
add